PROCEEDINGS

of the

Pan-American Road Congress

Held Under the Joint Auspices of the

American Road Builders' Association

and the

American Highway Association

with the cooperation of the

Pacific Highway Association

and the

Tri-State Good Roads Association

at

Oakland, California

September 13, 14, 15, 16 and 17, 1915

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PREFATORY

It has been deemed expedient, in presenting to the members of the Pan-American Road Congress the official records of its proceedings, to give an outline of the work of organizing the Congress. The record of the various steps has been gleaned from the voluminous minutes of the meetings of the Executive Committee, and notes the salient features involved in the work of creating a road congress covering the highway interests of all America.

The Pan-American Road Congress was held at Oakland, California, September 13, 14, 15, 16 and 17, 1915, under the auspices of the American Road Builders' Association and the American Highway Association, acting jointly.

A joint convention or road congress had been urged for some years by members of both organizations and by others interested in highway improvement. The receipt by each association of an invitation from the authorities of the Panama-Pacific International Exposition to hold its 1915 annual convention at or near San Francisco seemed to offer an opportunity for such co-operation.

Preliminary discussion and action resulted in the creation of a joint committee consisting of two members from each Association. These were authorized to select a fifth member, who should be Chairman, the five to constitute an Executive Committee to organize and conduct the Pan-American Road Congress.

The Committee consisted of Major W. W. Crosby, formerly Chief Engineer of the Maryland State Roads Commission, and E. L. Powers, editor and publisher of "Good Roads," representing the American Road Builders' Association; and James H. MacDonald, formerly State Highway Commissioner of Connecticut, and J. E. Pennybacker, Chief, Division of Road Economics, United States Office of Public Roads and Rural Engineering, representing the American Highway Association. These met in New York January 8, 1915, and unanimously chose Governor Charles W. Gates of Vermont, formerly State Highway Commissioner, as the fifth member and Chairman.

On March 18, 1915, the full Committee met at Montpelier, Vermont, for organization. Sub-committees were created as follows:

Arrangements, Mr. Pennybacker; Finance, Mr. MacDonald; Program, Major Crosby, and Publicity, Mr. Powers.

Mr. MacDonald was made treasurer of the Executive Committee and directed to solicit funds. Disbursements were directed to be made in payment of bills approved by one of the sub-committees and the Chairman of the Executive Committee. He was also authorized to employ Charles P. Light as assistant in securing contributions for the Congress for a period not exceeding three months.

The various sub-committees were directed to prepare plans for their respective departments of work, and submit same to the Executive Committee at its next meeting.

The subsequent meetings of the Executive Committee were held at frequent intervals at the office of the American Road Builders' Association in New York City, until the final meeting before the opening of the Congress, which was held at Oakland, September 12. During the various meetings from April to September, the work was developed as follows:

It was decided that the Pan-American Road Congress should be held at Oakland, California, September 13 to 17 inclusive. A tender of Exhibition Hall and other rooms in the Municipal Auditorium by the city of Oakland was accepted, as was also the offer to supply the badges for the use of the delegates, members, and visitors.

The program was arranged to consist of ten sessions, two each day, from Monday morning to Friday afternoon inclusive. Twenty-seven stated subjects constituting a logical sequence of the various factors involved in road and street administration, construction and maintenance were designated, and men prominent in the especial branches were invited to prepare papers, and others, also prominent in highway work, were invited to lead in the discussions of the papers presented. The persons selected for the preparation of these papers and discussions were communicated with by the Committee on Program, and acceptances reported to the Committee on Publicity.

On invitation, and by arrangement with the Exposition management Wednesday, September 15, was designated as Pan-American Road Congress Day at the Panama Pacific International Exposition, and the afternoon session was held at Festival Hall on the Exposition grounds.

Charles F. Stern, a member of the California Highway Commission, was appointed representative of the Executive Committee on the Pacific Coast. Local representatives of the Executive Committee were appointed in different sections of the country to act under the direction of the Committees on Arrangements and Publicity in carrying out the work.

A special committee on invitations was elected, consisting of Governor Gates, Mr. Pennybacker and Mr. Powers. This Committee, under the authority conferred upon it, pre-

pared invitations to appoint delegates and forwarded same to the executive officials of the Canadian government; the Canadian provinces; the Central and South American governments; the states of the Union, and the Permanent International Association of Road Congresses. Later invitations to attend the Congress were sent to all highway officials in the states of Arizona, Colorado, California, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington and Wyoming; and to all state and county highway officials in all other states of the Union. Also to the highway officials of all municipalities of 5,000 or more population, and to a number of other municipalities and organizations selected by the special committee.

Memberships were divided into two classes; those of Donor Members and Temporary Members. Donor Members were those who contributed not less than $50 to the funds of the Congress. Donor Members were entitled to have their names listed in the final program; were permitted to designate one Temporary Member for each $10 subscribed; and the Donor Member and Temporary Members designated by him should have full rights of participation in the proceedings of the Congress, and receive a copy of the official report when printed at the close of the Congress. Temporary Members other than those designated by Donor Members were to pay a fee of $2, and be entitled to all rights and privileges of participation in the Congress, including the official report of the proceedings. Members of the American Road Builders' Association and of the American Highway Association in good standing as of June 1, 1915, were entitled to the same privileges as Temporary Members, without further cost, including a copy of the official report of the proceedings.

Arrangements for participation in the Congress were made with the Tri-State Good Roads Association, of California, Oregon and Washington, and with the Pacific Highway Association, which is promoting a highway along the Pacific Coast from the northern to the southern international lines. Thursday, September 16, was designated "Pacific Highway Day."

Provision was made for a special Pan-American Road Congress train, under the direction of the Committee on Arrangements. The itinerary of the special train is given elsewhere.

Fifty thousand copies were printed of a preliminary program. These were distributed to Donor Members, manufacturers and others especially interested, and to others where it was considered that they would be advantageous.

Advance papers and discussions which had been received by the Committee on Program were put in type, and proofs

furnished to such of the technical press as had become Donor Members of the Congress, with release for publication on the date of their presentation at the Congress.

Special press matter was sent weekly to over 2,000 daily newspapers throughout the United States and Canada, and to the leading trade and agricultural publications, the first installment being accompanied by a personal letter to the editor. Articles for publication were also sent to several thousand leading weekly newspapers throughout the country.

The final meeting of the Executive Committee previous to the Congress was held at Oakland, California. The Hotel Oakland had been secured as headquarters for the Committee, and the meeting was held on the arrival of the special Pan-American Road Congress train September 12. Governor Gates, Chairman of the Executive Committee, who was with the special train, had just received word of the death of his mother, and after appointing Mr. MacDonald to act in his place as Chairman of the Congress, left for Vermont.

At this meeting, arrangements were completed for holding a banquet in honor of the local authorities and invited guests, Tuesday evening, September 14, at the Hotel Oakland. Other details for the opening of the Congress were concluded.

Monday, September 13, the Pan-American Road Congress was formally opened by Acting President MacDonald and the program presented as given in the succeeding pages.

At a meeting held in New York November 27 the reports of the various committees were received. The Committee on Program was discharged, its work having been completed. Reports of the committees on Publicity and Finance were approved to date; final reports to be furnished after the publication and distribution of the Official Proceedings of the Congress, and the settlement of accounts.

At this meeting the following resolutions were unanimously adopted:

RESOLVED, That after examination of the correspondence of the Treasurer of this Committee we do not consider that in his solicitation of contributions toward the Pan-American Road Congress he has exceeded his instructions or in any way bound either the American Road Builders' Association or the American Highway Association not to hold a convention after January, 1916; and be it further

RESOLVED, That we do not consider, in view of the facts mentioned, and others incidental thereto, that this Committee has in any way bound either the American Road Builders' Association or the American Highway Association not to hold one or more conventions after January 1, 1916, though we do consider each association bound in good faith

not to hold or as an association to participate in any convention during the calendar year 1915.

THE PAN-AMERICAN ROAD CONGRESS TRAIN

The special train carrying members and delegates and their friends left Chicago at 6:45 p. m. September 2, and arrived at Oakland, Cal., at 6:20 a. m. September 12. The route was over the Chicago & Northwestern Railway to St. Paul, Minn.; over the "Soo" line to the International boundary; over the Canadian Pacific to Vancouver; by steamer to Seattle; over the Northern Pacific to Portland, and over the Southern Pacific to Oakland.

The first stop for entertainment and inspection of places of interest was at Banff on September 5, where the members of the party were taken in tally-ho coaches to Tunnell Mountain and to Buffalo Park. The following day the party visited Lake Louise and the Glacier from which it is fed.

On the trip from Vancouver to Seattle through Puget Sound on the Princess Steamers of the Canadian Pacific line, a stop of two hours was made at Victoria, and a motor trip made over the improved roads of the immediately surrounding country. A similar trip was made over the roads in the vicinity of Seattle.

At Portland, Oregon, the party was taken in automobiles for a considerable distance up the Columbia River, over the recently completed Columbia Highway, an excellent example of expensive and difficult construction. At Crown Point the party lunched at Crown Point Inn, as guests of Samuel Hill, who personally arranged and conducted the inspection trip over the road.

Governor Charles W. Gates, Chairman, and James H. MacDonald, were the two members of the Executive Committee of the Pan-American Road Congress on the special train.

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Proceedings

of the

Pan-American Road Congress

OPENING SESSION.

Monday, September 13, 1915

The Pan-American Road Congress, held at Oakland, California, September 13-17, 1915, was called to order by Major W. W. Crosby, of Baltimore, Maryland, Monday morning, September 13, at 11 o'clock.

MAJOR CROSBY: As chairman of the Program committee I take pleasure in presenting as the presiding officer of the Congress Mr. James H. MacDonald.

(James H. MacDonald then took the Chair.)

CHAIRMAN MAC DONALD: It is my very unpleasant duty to say to the delegates assembled that Governor Gates, who was to preside over the deliberations of this congress and open it with an address, has been suddenly called home owing to the death of his mother. It is a great misfortune for us to be denied the pleasure and the profit that would accrue to this congress and its deliberations by his presence. I know that the governor had planned to have a very, very enjoyable time, and the executive committee was very fortunate in the selection of Governor Gates to be a member of its committee and to preside over its deliberations as chairman, owing to the fact that for ten consecutive years he had served his state acceptably, inaugurated and carried on successfully the administration under his highway commissionership. He occupied the unique position never accorded to any other commissioner in this country of having been selected as the chief executive of the state over which he had served as highway commissioner during the ten years prior to his induction in office. When the governor asked me to take his place he said:

"Now, Commissioner, I wish I could be there. I shall simply come to the door and knock, see that arrangements have been properly made and the plans of the committee successfully started, and then I shall go home to perform the sad office—the saddest that ever can come to a son.

"I wished to say to this congress that there may be subjects discussed in which you can find no concert on your part to join in, but that I want every delegate here to feel that whether the subject matter discussed is that which would be best for his state or not, whether the subjects are too elemental in their discussion or in their scope, that you

are all free in this congress to ask anything that may occur to you; to discuss this great question broadly, and from the standpoint of every political or geographical condition that the particular district or state or city that you represent may have to contend with. If you feel that you should match your improvements dollar for dollar with that which you arrange for; if you believe in a gravel road system; a water-bound macadam system; a plain piece of grading; the laying of a foundation; the introduction of drainage; leaving aside the question of service, discuss that, and we will be glad to hear you."

In other words, Governor Gates had won his spurs in the state of Vermont and he felt that even though they were getting an appropriation from the legislature it was not quite up to the standard it should be. So naturally this would have been the doctrine he would have introduced had he been here.

With this little thought advanced from Governor Gates allow me to say in behalf of the executive committee that has had charge of this gathering together of you delegates, that this is another epoch in the history of road making; in which these two great associations are joined, that comprise in their memberships the greatest aggregation of road builders, not only that this country has ever known, but any country in the world (applause), embracing every highway commissioner in the United States, men who have had to deal with this question from its inception, from the days in which King Mud held thraldom over the whole United States, over the sum of 2,500,000 miles of road.

Today, after an existence of only twelve years since the birth of one of the organizations, we find that nearly forty states have entered upon highway construction, and that where millions and millions of dollars had previously been expended all over the United States foolishly, wastefully and extravagantly, today one hundred and fifty or one hundred and seventy-five millions of dollars are being wisely and economically expended under the administration of these gentlemen, and the only degree of permanency that has ever been known in the road history of the United States has been that which has been established since the inception of these gentlemen as highway commissioners or in control of highway districts of their several domains. (Applause.)

When the Associated Press in its wide scope, in its ability to gather news from all points of the country, dignifies an item sufficiently to send it broadcast throughout the land through all the newspapers, these great vehicles of thought and information that find their lodgement in the firesides of all our people, it is worthy of notice. It was only last year that they sent out an item that in one of your western towns

they had dug up a street and had found on analysis that six dollars and fifty cents' worth of gold could be secured out of a ton of the dirt. Ah, but if that had been reduced to a mathematical calculation of all the millions and millions of tons of which no notice has been taken that had been shifted from the gutter to the center of the road and had taken the taxpayers' hard earnings only to be washed away in the village sluice, what an item that would have made? And when those Forty-Niners came over here looking for gold, some to go back enriched and some to go back disappointed, that is another item; but I want to tell you that it has no place in the history of the country like the gathering together of these pioneers today in this great movement of highway reform, in its influence, not alone for the few that came across the continent the first time, but for the people for all time in the making, in the building up, in increasing the population and wealth of the entire country.

We had a very pleasant visit as we came along through the Canadian Rockies and down through Vancouver and Victoria into Seattle—that little company that came in a special car to this congress. We were delightfully entertained in the states of Washington and Oregon, and then when we got here we received on every hand a hearty welcome.

We have seen your beautiful roads and we have seen many features which have not transpired in the history of any eastern commissioner during his term of office, both in that celebrated and splendid Columbia road that we went over and the splendid improvements that are being made in the Siskiyou Pass.

It is a great privilege that we enjoy, gentlemen, in coming here to take you by the hand and extend a greeting from all parts of the country, commingle in thought with yourselves with the lively hope that from this little meeting may come to us all some benefit. We do not come here as teachers. We come here as students. We come to learn from you and for you to learn from us, and all I have to say is, God bless the deliberations of this congress in all that it has to do with this great question. (Applause.)

With your permission I will appoint the committee on credentials, and the members can repair to the lobby and get the names of those who are registered and report at a later session of the congress. I will ask Mr. E. L. Powers to read the names of the committee.

MR. POWERS: J. E. Pennybacker, chairman; Herbert Spencer, George W. Cooley, C. S. Luck, Frank Terrace, C. D. Knight, J. H. McClintock, A. J. Hill, of Portland, Oregon; A. A. Hall, of Ohio; J. H. Pratt, W. R. Roy and W. T. Dust.

CHAIRMAN MACDONALD: I am very happy to announce that Mr. J. E. Pennybacker, who has had charge of the committee on arrangements reports to me that the Tri-State Association have very considerately and very kindly agreed to adjourn their convention, which is being held in San Francisco, and come over here and participate in our sessions. I know you will all be glad to learn that.

Governor Johnson has been detained, but we have a splendid representative in Senator John W. Stetson, whom it is my great pleasure to introduce to this convention. (Applause.)

Address of Welcome on Behalf of the State of California

By SENATOR JOHN W. STETSON

Mr. Chairman and Members of the Pan-American Road Congress: I have no doubt that Governor Johnson would, if it were at all possible in accordance with the manifold duties that are resting upon him at the present time, like to be here. He is an enthusiastic supporter of every movement that tends to the facility of our highway traffic, and is now, among other things throughout the state, supporting the bond issue which will nearly double the present available funds for the construction of permanent state highways in California. The election is to be on the twenty-sixth of next month. It may be for a particularly selfish reason to California that we give to this congress the heartiest of welcomes, because it so appropriately comes here with its message and work concerning highway construction at a time when we want the public mind to have its attention called to what it is doing. That is one reason why so hearty a welcome can be extended to you; and the other one, and we trust you will think it is no less sincere, is the reason that California is able to offer you, especially as experts in good roads at this time, a consideration, and under very pleasant circumstances we think, of manifold problems which perhaps more than any other state in the Union will include all the various problems that you gentlemen from the different states have to deal with, especially in your own localities. Of course in California there is not the question of swamp construction and preliminary drainage necessary to the construction of roads, at least not in any great amount; and in California we do, perhaps, have to deal especially with the problem of the long dry season, which is of course a necessary consideration in the construction of certain kinds of highways which it is desired to have made permanent.

The history of good roads and road agitation in California is very recent. The first time the state ever took the matter into its hands was when the people in 1909 voted a bond issue of $18,000,000. And they voted it very readily without

understanding what was being aimed at or what the result would appear to be when it was accomplished, and indeed without providing any method for the maintenance of such highways once they were constructed. But it was the beginning, and a beginning even ill-advised is better than sitting still and doing nothing in governmental matters as well as in our private concerns. So when that eighteen million dollars was voted under a direction that it be applied to a chain of roads connecting the various country seats it was discovered that the political exigencies which made it necessary to plan the vote that way nevertheless provided for a system of roads many of which were not immediately important from the point of view of traffic as others which were left unprovided for. There is a secondary issue that is to be voted on next month that will provide, it is hoped, the money to supplement construction necessary over at least the greater arteries of California road districts.

Fortunately the great development of the use of automobiles provided the methods whereby taxation could be laid upon willing shoulders to produce money which in large part will suffice to maintain the roads which are being constructed under the eighteen million dollar bond issue. It is one of our western boasts, you may hear it from others before you get away from here, that California stands second in the number of registered automobiles in any and all of the states of the United States. The importance of the problems that you are to consider is perhaps realized by you and by those acting with you in the support of road building. They are not perhaps understood and appreciated generally by the public, although that condition is rapidly changing. Economically the existence of good roads has an importance it is difficult to overrate. The problems of political economists are said to have enhanced many fold in recent years in these United States of America by the congestion of population, by the necessity of framing laws which will provide for a condition where elbow room is cramped. The question of good roads is a natural and feasible and permanent giving of more room in the same locality to a population. It enlarges the boundaries of cities, which, after all, are not measured by distances, but measured by time.

One of the things that our early pioneer fathers in California did with reference to roads was to have just one rule, and that was that a good road was the shortest distance between two points. It turned out very often that a good road was the steepest distance between two points, and the trouble in all of our mountain districts of California is, notwithstanding the existence of our great valleys that include by far the larger portion of the state, we have been beset by roads that have been regarded by impar-

tial observers as being the steepest roads in the world. Construction nowdays, however, recognizes the fact that the longest way round is often the shortest way home, and we are finally getting some better grades. Some grades are being built upon the idea that has long existed in the railroad world, and which are particularly suitable to the automobile. Even a man with a single cylinder motor is finding that a good grade gets him to his destination the quickest in many instances, to say nothing of the safety and comfort which he derives from it.

That brings me to a consideration of the other economic result that is flowing from the agitation for good roads. That is, the proposition that it is a direct and decided saving from the point of view of maintenance and expenditure, maintenance of the running gear of all vehicles, and in the expenditure that has been made for freight and passenger traffic; and it is going in the end to profoundly affect the problem that confronts the railroad man. It has already profoundly affected the men in the city who have been accustomed to dealing with the congestion of population, because they were left in town and restricted there by the condition of the roads.

In a word, it is making for a freer and fuller life of all the people. It affects everybody. It affects them financially, it affects them socially, and you gentlemen can engage in your deliberations with the full knowledge that you are engaged in a work which is of importance to everybody, which is of great and growing importance, and that, much as has been done already, you are the pioneers in a movement which will not meet its fruition for fifty years in the United States of America. When it does this country will be a different place to live in. Everything that has been done will be in the direction of the uplift of the economic and moral life of the people. These are some of the reasons that impel us in California, officially charged with the duty of welcoming you here, to say that that welcome is heartfelt and not provincial, and we trust that when you have finished the labors which you have met together to perform that you will feel that you have had the sympathy and cordial good will of all the people here who have the honor of having you as their guests; and that you will be able to find a little time thereafter to look about and see some of our good roads and be moved by some of our bad roads; and that you will find time to get the relaxation which is offered you by the wonderful exposition in San Francisco and by the greater exposition that we believe California offers to all of our guests who will ramble about. We have some roads now we are proud to show you and that will give you an idea of the direction in which we are traveling. Again,

on behalf of Governor Johnson, I bid you a hearty welcome and wish the greatest success to your deliberations. (Applause.)

CHAIRMAN MAC DONALD: I have to announce that Governor Lister of Washington is not here, but he will be very ably represented by the head of one of his executive departments, the state treasurer. I take great pleasure in introducing Mr. A. E. Meath, who will respond for the state of Washington. (Applause.)

Address of Welcome on Behalf of the State of Washington
By A. E. MEATH

Mr. Chairman and Members of the Pan-American Road Congress: Before I left for this congress I was delegated by our Governor to represent him. I am also informed that he has three other representatives here who are better speakers than I am. I wish to state this, that while we have a young state up there we are progressive in road building and are building good roads. The chairman said that we come here to learn. That is why I am here, to learn the art of good road building. In the state of Washington we are building our roads now on the road levy. The state makes a mill levy for the public highway fund. The permanent highway has a mill and a quarter. This is built by the various counties under state supervision. I could talk single-handedly to all of you on the road proposition, but I came here to learn. I would sooner have you hear from the others of our state. We have quite a few here from Washington and any one of them is better posted on roads, really, than I am. (Applause.)

CHAIRMAN MAC DONALD: I know we are all very grateful to Mr. Meath, but if, as suggested by Mr. Meath, we could have Mr. Frank Terrace, if he is in the room, come up here and tell of the pioneer days and the struggles to get them started, I know we would all have a rich treat. (Applause.) From my visit eight years ago to the Pacific coast I noticed quite a change in my visit the other day, and no man has done more to bring about that change than the man who is going to speak to you now.

Address by Frank Terrace

Mr. Chairman, and Ladies and Gentlemen: It affords me great pleasure to meet once more with the old pioneers in this great road movement. We have had our ups and downs in this movement. Sometimes we have had fair winds and sometimes we have had foul winds, but we have all forged ahead. I might say that every state in the Union and every county in the Union as well has forged ahead. I might tell you that the hardest class of men to reach in this whole

United States of ours is the farmer, and he is the man whom good roads will do more good to than any other man in this country. But he is now awakening to the needs and necessities of good roads.

Now let me tell you a little of the ups and downs in our state. I live in a valley which is probably the best piece of land according to its size in the whole United States. (Laughter.) It is made of decomposed ash by overflows from Mount Rainier, a hundred feet deep, without a particle of grit in it, and you could eat every rock that you can find in the valley. You can depend upon it when we had no roads there was no bottom to that valley. I agitated and I advocated better highways in my own humble way, but I made very little progress. I appealed to pride, but it was no use. When you talked about building these high-class roads to a lot of impoverished farmers they threw their hands up in holy horror and they hadn't business qualifications enough to know that if they had better roads they could haul their produce to market when the market needed their produce instead of letting it rot on the ground in the winter time, as it used to do in our valley. We got the county that I live in worked up to a pitch to build a mile and a half of a sample road. This was a hard piece of road to build, along the banks of the Duwanish River, where it had to be rip-rap. It overflowed, but that mile and a half of road was properly built, costing twenty-two thousand dollars a mile. The road was built in the fall of the year. I have lived in that valley for thirty-five years. The road was no sooner finished than there was a flood. Nine feet of water stood on top of that road and it was there for nine days, and they said, "Terrace, your road is gone down the river." I never slept for nine nights, because I knew if the road had gone down they would have hanged me. (Laughter and applause.) But, Mr. Chairman, when the road came up out of the water she was no worse for being under nine days. The farmers started to use that road. And when they were coming down that road with a wagon tongue flying from side to side and the steam flying off the horses and the driver with whip in hand to avoid chuck-holes and mud-holes, and the horses climbed up onto that mile and a half of beautiful road, that driver put his reins down into the socket, he took his pipe out and he lit it and the horses went along wagging their tails from side to side. (Laughter.) God bless my life, the horses had more sense than the men, but Mr. Chairman, when the horses got at the other end of this mile and a half of beautiful road, and had to fall down into the mud and swamp, they hesitated to take that mud again; but, Mr. Chairman, the man that lit his pipe and threw the lines down and saw the horses wag

their tails from side to side, he was looking down on that mile and a half of road. That mile and a half of road did the work. It was like a good restaurant. You can depend upon it if you have a good meal in a restaurant you will not only go there again, but you will take your neighbors. That mile and a half did its work. The farmers wanted three miles more on each end of this road, the very fellows that would have taken the stars down—they were so much opposed to putting their money into a highway—and when we got up to the forks of the road where the valley is equally divided, with the farmers one-half on the east side and the other half on the west side and only money enough for one road, they fought for two long years, pretty nearly killing one another, over who was to get that road. Quite a change and quite a difference from what there was when they were going to hang me for advocating a better road.

Well, we have gone on and we have gone on, and what are we doing today? We are building some of the best roads in that little state that there are in the whole United States. I have visited pretty nearly every road in this great country of ours, pretty nearly in every state in this Union, and I know what I am talking about when I say it. We have a brick that cannot be beat in this whole country and we are laying some of our main roads with some of this brick, costing thirty-two thousand dollars a mile. You never hear any complaint from the farmers that are using these high-class roads. Why? We didn't go into this thing with a rush; we went into this thing with one mile and a half of sample road only, costing twenty-two thousand dollars a mile. If we lost our money we didn't lose much, but we didn't lose our money. We made money. We got a hundred per cent. on our money that was invested and the farmers knew it; and the farmers woke up to the necessity of better roads and better highways. Why shouldn't we? We don't know what we have got out here in this great and beautiful country of ours. We have inherited here one of the finest pieces of country that God ever let the sun shine on. I was amused last Christmas when I was in Chicago. I heard the Mayor of Chicago, Mayor Harrison, who is well known all over this great country of ours, get up and speak about the great state of Illinois, about the great possibilities and her great natural resources. The next man got up and spoke about the city of Toronto and the province of Toronto, and what they had done. The next man to get up was the Mayor of St. Paul and he told them there that he represented the great bread and butter state of this Union. Finally the toastmaster called on me. I didn't only represent the state of Washington, but your honorable servant here also represented the state of Oregon, because I have labored as well

in the state of Oregon for better highways as I have in my own state. I gave a little record of what we had done out in this corner of this great country of ours. Fifty short years ago the Indians were smoking their salmon where Second avenue now stands. In that short space of time we have built a city of 320,000 population, the best lighted, the best paved, and the best watered city in the whole United States. (Applause.)

I says, "Mr. Toastmaster, the Mayor from St. Paul tells you that he represents the great bread and butter state. Now you follow me and I will take you into the land of milk and honey. We will not only give you bread and butter; we will give you beef and mutton; we will give you fish galore. We will give you fruit of all kinds. We will give you hops to make your beer and grapes to make your wine. We will give you timber, the finest that the world has ever seen, eight and ten feet in diameter on the stump, and running 200 feet to the first limb. We will give you coal, gold, silver and copper; in fact, if we were building a wall so high around our two states that nobody could get out we would enjoy more luxuries than any people on the face of God's green earth." (Laughter.)

But, Mr. Chairman and Ladies and Gentlemen, when we have inherited this beautiful gift we have not stood idly by. We have pulled our coats off in these great states and we have gone to work, and we have put the finishing touches on, and we are building roads north, south, east and west across our states, making them happier and pleasanter for the people to live and much easier for the farmer to make a living in. But our work is only begun.

When I came up the coast I landed here this morning from the boat. In my berth last night I was studying over conditions, the conditions of the world. There is all along the coast of Washington, the coast of Oregon, and also part of the coast of California no road. If an army should invade these shores tomorrow anywhere along this coast we couldn't transport our troops to meet it. You have got neither railroad nor wagon road there to carry your troops over to defend your homes, and I think it is a question for this great convention to take up that the national government should build that road as a military road along the coast from here up to the Puget Sound, because you must understand Europe is getting a lesson these days for being unprepared. I hope that this great congress, before it adjourns, will take up that matter. Now I will give you a road talk before we get through. I haven't begun today, because I didn't expect to be called on right now. (Applause.)

CHAIRMAN MACDONALD: I regret to say that Governor James Withycombe is not with us today, but I would

be very glad to have any one representing the state of Oregon come up to the platform and tell us what you are doing there. Is there anyone here that wants to represent the state of Oregon and tell us something about what you are doing?

Is the Hon. John L. Davie, mayor of Oakland, present? If not, we have a splendid representative in the gentleman who has done so much towards the organization and the carrying out of that magnificent exposition that we have here, that is attracting the attention of the world, and I know you will be very glad to know that in the absence of Director Barr his very able and efficient assistant, Mr. H. K. Bassett, will favor us with some remarks in regard to the splendid exposition that we are all enjoying.

Address by H. K. Bassett

Mr. Chairman and Members of the Convention: I hear the twelve o'clock whistle, which I imagine is one of the reasons why Mayor Davie is not here. I understand the council is in session from eleven till twelve. I come with very hearty and very sincere greetings from the exposition, and peculiarly personal from our chief, Mr. Barr, the director of congresses, because his and ours have been a very personal and intimate contact with the officers of this as well as of the other organizations who are meeting here during these ten months. There is on the shores of San Francisco Bay a most wonderful, a most beautiful exposition, a veritable Fairyland. I needn't tell you about it, because you have arranged your program. You have arranged a trip there so that you may see something of it. It is one of the inducements which has brought you here, but it seems to me that for the moment this great exposition is commemorating the opening of the Panama canal, an event the historical significance of which is of no greater importance than is this great good roads movement all over this and other countries. That stands out as a rather salient and wonderful engineering achievement, and yet the sum total of the value of the Panama canal to mankind surely is no greater than that which will accrue to mankind through the development of good roads all over this country. It seems to me peculiarly appropriate that the exposition which commemorates the opening of the canal should have a very small part in welcoming you to these shares. It honors itself in welcoming you and it welcomes you most heartily and most sincerely. I speak very informally, but very sincerely, for the entire exposition directors; for President Moore, for the directors and for our own department, which through nearly three years has had very intimate correspondence with the officers of this organization.

I may state that this is just one illustration of what we have attempted to do through these ten months, to have the organization bring with it the allied organizations of similar interests. So we have here two of the great organizations giving up their individual meetings that they might be merged in the Pan-American Road Congress; and then the Tri-State, the local organization, which is meeting this morning over in San Francisco, concluding its individual sessions today and then joining with you. Therefore, we have through this week the great road-making period of the exposition here. Last week the dentists closed a two-week period, which mean that the dental fraternity all over the country might come and within ten days get the cream of the discussion of the dental subjects from all over this and other countries and at the same time see the exposition and see this coast. In just a few days, beginning this week, in fact, come the engineering forces with separate and individual organizations meeting this week and all merging in an engineering congress next week. So it is with the insurance forces, the medical forces and the educational forces. So you can realize how personal is the welcome that we offer you and how very sincere and genuine it is, because this is the combination of the weeks and the months, the years in many cases, of correspondence and of intimate contact that we have had with your officers. So I bid you a most cordial, a most sympathetic and heartfelt welcome for the exposition over there. (Applause.)

CHAIRMAN MACDONALD: I would like to have the delegates pay special attention to the announcements in the program for the entertainments that have been provided, and perhaps I should, before taking up the announcements, say that the proceedings of this convention will be of inestimable value and be a text-book for all time. I think it goes without saying that you have comprehended in this program the men of this country who are most influential, who are the greatest students and who have had the largest experience in the science of road building in the history of the world. Now these proceedings will be printed after our sessions are through and will be sent to the members of either association in regular standing last June, and all other delegates that are present at this congress who are made temporary members by card for the nominal price of $2, and in addition the temporary members will receive all of the enjoyments and the hospitality that comes to the delegates, with all the privileges of the session, together with the copy of these proceedings. Now the cards will be outside, and it is only necessary to fill them in the lobby as you come in or go out.

Now we have to announce an automobile inspection trip

on Saturday. That will be a delightful privilege to be enjoyed by all. Then tonight we have over at the Oakland Hotel, through the courtesy of the local committee, a smoker at 7:30. We would like to have you all there. The banquet will be at the Oakland Hotel on Tuesday evening. The tickets for the banquet will be on sale here in the lobby, and also over in room 200 in the Oakland Hotel. Then there is to be a trip to the Yosemite National Park, and an excursion on Sunday. A registration for these events may be made at room 200 in the Oakland Hotel. Now you will excuse me for making those announcements, but they are important matters and I thought perhaps you would like to know them. I think it would be well to notice before you go away that a group photograph will be taken of all the delegates present immediately at the close of this morning's session.

We will now proceed with the program. The next address will be by the president of the American Road Builders' Association, one of the two associations that are holding this joint convention, and the oldest association that we have, Mr. G. W. Tillson. (Applause.)

Address

By GEO. W. TILLSON

President, American Road Builders' Association

Mr. Chairman and Gentlemen of the Pacific Coast: It certainly is a pleasure, as well as an honor, for me to appear before you today as a representative of the American Road Builders' Association to thank you for your kind expressions of good will and words of welcome.

The American Road Builders' Association is made up of members residing almost wholly in the eastern and southern parts of our country, practically all east of the Rocky Mountains.

For a long time the question of holding this meeting on the Pacific Coast was debated at the meetings of the Board of Directors, and it was finally decided that it should be held here and in connection with the American Highway Association. I feel, and I think all the other members of the Road Builders' Association feel, that no mistake has been made in the decision. While probably most of us had never seen this section of the country before, we had nevertheless read and heard a great deal of it, and we knew that while, if we did come here, we might bring a certain amount of information to the people of the Pacific Coast, still we also knew that we would at the same time gain a great deal of information for ourselves, and we were glad of the opportunity of paying you a visit. We had heard much of the enthusiasm, the energy and the self-confidence of the people

of your section, and we hoped that by this visit we would be able, by contact, to absorb some of this energy, enthusiasm and self-confidence in the same manner as the fabled Antaeus renewed his vitality by contact with the earth. From the little we have seen on the way out we are satisfied that we were not mistaken, and we are willing to impart to you all the information or knowledge that we have in return for what we have gained on this trip.

I wish, therefore, in behalf of the American Road Builders' Association, to thank you individually and collectively for the hospitality and courtesy shown the members of this association, and we trust that the time will come when the members of this section will visit the East so that we can reciprocate in a small way the courtesies which we have received from you on this occasion.

The American Road Builders' Association was formed in 1902. Its object, as stated in its constitution, is "to acquire and disseminate information concerning highway construction and maintenance in the states and cities of the Union and in the provinces and cities of Canada; to stimulate interest in the subject, and to promote educational, legislative and other measures tending to their accomplishment."

During the years that this association has been in existence it has held meetings annually, with the idea of furthering the aims just enumerated, and it feels that it has accomplished a great deal along those lines. Since its organization, scientific road making in this country has been inaugurated and developed to a wonderful extent. It has seen the ordinary country road transformed into one which will compare favorably with the boulevards and streets of our cities, and it has seen thousands of miles of roads constructed at a cost of millions of dollars all over the country.

It is convinced, however, that something more is necessary to the construction and maintenance of a highway system than a knowledge of specifications and proper construction, and this brings me to a point to which I wish to call your special attention and that is the great importance of continuity in public work policies.

This country, being practically in its infancy, has not had, until recent years, very extensive public works, and it is not strange that definite and positive policies for carrying them on from year to year and from generation to generation have not been developed. But this is a matter of great importance, and without it no scheme of public works can be carried on economically and efficiently. One definite policy carried on from year to year and decade to decade will often produce better results as a whole than many different policies, even if they are all individually better. Individual ideas differ, and changes are made which, even if they produce better

results at the time being, create such confusion that the final results do not differ very much economically or physically from the original plan systemically carried out.

This principle of continuity of policies, however, is beginning to be recognized. It has been recognized and adopted for many years in Europe, and to a great extent in England; in fact, to such an extent that it is possible that it is being carried too far. The act establishing the English Road Board provides for the appointment of five members of the board, each for a period of ten years, one member retiring every two years. A prominent official of this board, on a visit to this country a few years ago, appearing before a committee of the U. S. Senate which was discussing a road matter, suggested to the committee the importance of protecting the road engineers of the United States by making their appointments permanent. He said, however, subsequently to the speaker, "If I had been giving evidence before an English committee I should probably have tendered different advice." This is because, as he stated, the young Englishman enters into the public service as a life work, because he knows the position is permanent. In this country young engineers as a rule enter the public service without any prospect of permanency. This idea, however, is gradually changing, especially in the larger cities, nearly all of which at the present time are governed by civil service rules, so that employees of a municipality are very seldom discharged except for lack of employment or for cause. For instance, an engineer has recently been retired by the Board of Estimate and Apportionment of New York City who had been employed by the city for fifty-four years.

But the point which I wish to bring out is not so much the permanency of the employees of a department, but the organization of a road commission, or any public works department, in such a way that changes in the political administrations will not mean changes in the organization of the commission or department, thereby making changes in policy.

How political changes may cause changes in administration as well as organization can probably be best illustrated by the conditions in the state of New York. The state highway work in this state was begun practically in 1898, when $50,000 was appropriated and the work placed in the hands of the State Engineer and Surveyor. The work continued under the different state engineers, so that it was possible for a change to be made every two years, and, in fact, in the first ten years the work was carried out by four different state engineers. In 1907 a bond issue of $50,000,000 was authorized, and in 1908 a highway law was passed providing for a State Department of Highways, under a commission form. This law became effective on January 1, 1909,

and a commission was appointed and proceeded with the work. The Legislature of 1911 abolished this commission and substituted in its stead a Superintendent of Highways, with the State Engineer and the Superintendent of Public Works ex-officio members of a commission. This commission held office until 1913, at which time the three-headed commission was abolished by the Legislature and the appointment of one commissioner substituted. The commissioner thus appointed held office for a little less than two years, when he resigned and the present commissioner was appointed.

From the time the first work was started, in 1898, up to the present, thirteen men have been in charge of highway work in the State of New York. With such changes, not only of individuals but of commissions and policies, is it possible for good and efficient work to be accomplished?

It might be said that in addition to the $50,000,000 heretofore alluded to, subsequently another $50,000,000 was voted for by the people, so that since 1898, in addition to the relatively small appropriations made by the Legislature, the road authorities of New York have had $100,000,000 to expend on state roads.

It should be said, however, that, despite all these changes, political as well as individual, the work of the New York State Highway Department at the present time will compare favorably with that of any other state in the country.

A very different state of affairs, however, will be found if the history of the Massachusetts Highway Commission be examined. This commission was first appointed in February, 1893, and the law relating to the organization of the same has not been changed. The chairman of the commission is appointed by the Governor, and in the twenty-two years since the first commission was appointed there have been seven commissions, but composed of only ten individuals. In the appointment of the chairman, in every case except one, the selection was made of a man who had previously served on the commission, and wherever a commissioner has ended his membership it has been either by death or resignation. There have been but two secretaries to the commission, and the present secretary had been assistant secretary four years previous to his appointment. There have been but two chief engineers of the commission since its organization.

As might be expected, the work of this commission has been systematic and efficient, and first-class results have been obtained. By its continuous life it has been able to establish a policy and to continue it, bringing about expected results.

At the present time there is in existence in New York State a convention for drawing up a new state constitution,

to be presented to the voters of the state at the November election. The engineers of the state, recognizing the importance of establishing a definite scheme and policy for state public works, formed committees from the American Society of Civil Engineers, the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, the American Institute of Consulting Engineers, the Municipal Engineers of the City of New York and the Brooklyn Engineers' Club, and formulated recommendations to the convention regarding the carrying out of public works. One of their recommendations was that there should be created a Department of Engineering and Public Works, to be headed by three commissioners appointed by the Governor, each to have a twelve-year term of office, so arranged that a vacancy would be created every four years immediately after the inauguration of a new Governor. They also recommended the creation of a Department of Public Utilities, to be headed by five commissioners appointed by the Governor, each to have a ten-year term of office, so arranged that a vacancy would be created every two years. Both of these recommendations recognize the importance of a continuing policy, and also provide how it should be brought about. Just what action will be taken by the convention on this matter of course is not known, but should this general scheme be adopted it will undoubtedly work to great advantage.

An example, however, of the continuing policy can be seen in the City of New York, in the construction of the new Catskill water supply. This work is being done under a commission appointed by the Mayor of the City of New York, with a chief engineer at the head of the technical staff. While there have been some changes in the personnel of the commission, one of the present commissioners was an original appointee, and the chief engineer of the board has been chief since the beginning. This is probably the largest system of public works ever inaugurated by any municipality. Its conduit is carried under the Hudson River at a depth of 1,100 ft. below the surface; it is continued down on the east side of the Hudson River to the city, carried under the Borough of Manhattan (the old City of New York) at an average depth of 200 ft., then under the East River, under the Borough of Brooklyn, and across the Narrows to the Borough of Richmond, or what is generally known as Staten Island. This enormous work has been carried out under the direction of one chief engineer, the same man from beginning to end, with wonderful success. Its success is due not only to the ability of the chief engineer, which is great, but also to the fact that the administration and the policy of the construction have been the same from the very beginning to the end, which is rapidly

approaching. The estimated cost of this work is practically two hundred million dollars.

This question of policy, gentlemen, is a problem that the American Road Builders' Association has discovered since it began to work. I trust that I have said enough to convince you of its importance and how necessary it is for all road associations to work, not simply for a knowledge of construction and specifications, but for the adoption of a scheme for carrying out these works and to bring about the proper administration in the field and in the office so that good construction and good results may be obtained from good specifications. If the American Road Builders' Association, by joining in this meeting here in this city, has materially advanced this idea of a continuing policy so that the different organizations both in the West and in the East will work for it as strongly as they work for good construction and good maintenance, I shall feel that the meeting has been successful, even should it accomplish nothing more.

CHAIRMAN MACDONALD: The next speaker is so well known that he hardly needs an introduction, and he will very ably represent Mr. Fairfax Harrison, who is the president of the American Highway Association. I take pleasure in introducing to the convention Mr. Charles P. Light. (Applause.)

Address

By CHARLES P. LIGHT

Representing President Fairfax Harrison, of the American Highway Association

Mr. Chairman and Members of the Pan-American Road Congress and the various associations represented here: I regret very much that Mr. Harrison, the president of the American Highway Association, is not able to be with you. I know of his vital, abounding and abiding interest in this great work. The American Highway Association was not organized as a technical body, but to carry on a campaign of education throughout the country looking toward the solving of some of the problems having to do not only with the construction of roads, but their maintenance, and the doing away of a lot of wastefulness that existed in the country. Mr. Tillson has very ably referred to one matter and that is tenure of office. He referred to New York state and to Massachusetts, and if not by comparison certainly by contrast I know you grasp the lesson that he desires to teach you. The most valuable thing to a man in road building as well as a great many other things is continuity of tenure of office. The American Highway Association has consistently carried on a campaign looking toward the elimi-

nation of partisan, political influence not only in the highway departments throughout the states, but in the various subdivisions of the states.

I myself am the most illustrious example of an extinguished and distinguished highway commissioner. (Laughter.) I was highway commissioner of West Virginia. I was a highway commissioner there, and they got mixed up. When I left the capitol of the state at three o'clock in the morning going east to my home I was commissioner. When I passed the first station, thirty miles east of Charleston, I was not a commissioner. Between the hours of three and four o'clock in the morning things happened to me (laughter), and they have happened to others since.

Gentleman, that ought not to exist. That ought not to continue. They have not happened that way in Massachusetts. I don't know how long Mr. Tillson has occupied the position that he occupies in the city of Brooklyn, but I know that Mr. Lewis has occupied his position in New York City a number of years. I know Mr. MacDonald occupied his position for a number of years. I know a commissioner is better today than he was last week, and as he continues in office that he will get better; and he will, if he is the right man to have the appointment. Each day, each week, and each month makes him more efficient. Therefore, we want to remove these public officials having to do with county work and state work from the effects of partisan political influence.

I also want to see the time when the national government will help the states on a safe and sane basis in the construction and maintenance of roads. We also want to see the time when not only the counties that have these men who are efficient, but a great many counties in this country who have not at this time efficient highway commissioners shall have them in charge of the expenditure of money. We want to substitute scientific knowledge of a technical character for guesswork. We want to see not only these roads built with durable surface and all the grades made, but dirt roads—the earth roads of the country—dragged as they ought to be dragged. We will always have eighteen hundred thousand miles of earth roads in this country, and why not maintain them and keep them repaired in the cheapest way rather than doing it at an excessive cost. There is a great opportunity for educational work in the country, and I am proud to be connected with an organization that is endeavoring to do those things.

As I said in the beginning, I know that Mr. Harrison would have liked to be here because he is vitally interested and is giving his time and his money toward helping us carry on our work. I also appreciate on the part of the people

out here the courtesies that have been extended the American Highway Association on the committees and anticipate, if I am allowed to do so, the treatment that will have been extended during the week. I am sorry that Mr. Harrison was not here yesterday to take a trip that I took. I am sorry I had to represent him on that trip. They have something out here we don't have, a sky-line. If you gentlemen have your wives with you leave them at the hotel and kiss them good-bye when you take that trip. I doubt if you will ever see them again. I have never seen anything like it and I don't ever want to see anything like it again. It was one of the few times in my life when I couldn't talk (laughter), and I really would not know what to say if I could have talked.

There are a number of things here for us to see and I am very glad personally, as well as the representative of Mr. Harrison, the president of our association, that this joint congress is being held. I am very glad that these bodies have joined forces and are looking toward the solving of great problems in transportation in our country. We are spending a lot of money, gentlemen, four hundred million dollars, this year for road and street work in this country as against approximately one hundred million dollars five years ago. Just think of that. Ten per cent. of that money is being spent in Mr. Tillson's state and city, approximately. Forty million dollars a year. States are anticipating further bond issues. This state here (California) twelve million dollars more; Pennsylvania in 1918 will vote for fifty million dollars. Now we must get together and keep getting together and keep striving toward the solving of problems so that we will not waste this money that we are taking from the people, but give them a dollar's worth of roads in return for the dollar spent.

I am very glad to be here myself and expect to stay here during the week. I have been here four days and I have had a corking good time, and if you fellows have as good a time the rest of the week as I have had since I have been here you won't have to apologize to anybody for not having a good time and not having some one take care of you. I want to say this. I don't want to hurt anybody's feelings, but when my time is up here I am ready to go back home. This is a fine country—to visit (laughter). I would like to stay here just about a week. It is so big you can get lost out here. It is so enormous, so great, so majestic, and it has done us a lot of good to come out here, we fellows of the East who have never been here and who have been bragging about what we have. Why, Frank Terrace knows more than I have forgotten (laughter). Frank Terrace is going to tell you a great many more things than he

has told you because he has thought big things, he has seen big things. This a great country and it gives us a different conception of what the United States of America is, and that is one reason I am glad the congress met out here. Just coming across the country we see what a great nation we are, and why shouldn't we try to solve the great problems of transportation? (Applause.)

CHAIRMAN MACDONALD: Just a word and then we will conclude the program. I will appoint the following members of the Committee on Resolutions. Will the Secretary read the names of the committee on resolutions, after which we will hear just a word from Mr. Egilbert, the commissioner of the California building?

MR. POWERS: G. W. Tillson, Chairman; W. T. Uhler, Capt. Walter Coggeshall, W. Tom Winn, Sam Hill, Lamar Cobb, Benjamin Gates, W. W. Crosby, W. T. Headley, A. E. Loder, C. M. Kerr.

CHAIRMAN MACDONALD: Mr. Egilbert will now speak to you.

Address by Mr. Egilbert

Mr. Chairman and Gentlemen of the Congress: I notice by your program you expect to spend a day at the exposition, and as one of the commissioners at the exposition and the Commissioner General of this state I extend to you for the fifty-eight counties of California an invitation to visit with them that afternoon after you have finished your more important work. In view of the fact that Brother Terrace extended a challenge to the mayor of St. Paul in Chicago that if his people would come out to the two states on the coast and build a wall, that they could live inside of that wall without asking the world to help them, I will place you people up against the representatives of fifty-eight counties of California who will show you that in one state, if they built a wall around it you would never want to go out of it. (Applause.)

CHAIRMAN MACDONALD: This concludes the exercises for the morning and we will have a session at two o'clock, at which the regular business of this congress will commence. We will have at that session "The History and Future of Highway Improvement," "The Relation of the Road to Rail and Water Transportation," "The Benefits and Burdens of Better Roads," "Roadside Improvement," "The Essentials of Proper Laws for Highway Work," "National, State and Local Responsibility for Road Conditions," and "Ways of Securing Improvements." I thank you all for your attendance this morning.

An adjournment was then taken until two o'clock p. m.

FIRST SESSION, 2 P. M.

JAMES H. MACDONALD: In the absence of Fairfax Harrison, President of the American Highway Association, Dr. Pratt has kindly consented to preside, so I have great pleasure in presenting Dr. J. H. Pratt, Secretary of the State Highway Commission and State Geologist of North Carolina; Dr. Pratt. (Applause.)

(Dr. J. H. Pratt then took the Chair.)

CHAIRMAN PRATT: Any little talk that I might make I am going to postpone until I come regularly on the program on Thursday morning, so there won't be any chance at all of repetition of what I have to say. Before taking up the program I want to read a telegram that came in this morning.

"Boston sends greetings to Pan-American Congress in Convention at Oakland this week. Cordially invites members to select Boston for 1916 meeting place.

(Signed) James H. Curley,
Mayor of Boston."

That will be referred to the secretaries of the two associations.

The first subject for discussion this afternoon is "The History and Future of Highway Improvement." The first paper is by the Hon. Logan Waller Page, Director, Office of Public Roads, United States Department of Agriculture. I was going to let Major Crosby speak to you without any introduction. He is representing Mr. Page and I thought those of you who did not know Major Crosby might think he was Mr. Page, but Major Crosby wants to stand on his own colors, so I introduce to you Major Crosby, of Maryland, who is representing Mr. Page. (Applause.)

MAJOR W. W. CROSBY: Mr. Chairman and Ladies and Gentlemen: I was afraid that I might be accused of attempting to sail under false colors and of impersonating Mr. Page, the distinguished director of the Office of Public Roads. Therefore I asked Dr. Pratt to explain the situation. I might say in justice to Mr. Page, who is deeply interested as you all know, both officially and personally in the road movement and in this particular road congress, that Mr. Page expected to be here and prepared a very valuable paper at my request as chairman of the program committee. Unfortunately as he was about to start he found that it would be absolutely necessary for him to have a personal conference with the Secretary of Agriculture in relation to the estimates for his department which had to be included in the budget for next year. The necessity of that personal interview, which of course takes some time, with the Secretary of Agriculture at the latter's convenience, has prevented Mr. Page from personally addressing us. I will, how-

ever, with your permission read his paper on "The History and Future of Highway Improvement."

The History and Future of Highway Improvement

By LOGAN WALLER PAGE

Director, U. S. Office of Public Roads and Rural Engineering

From the standpoint of construction, the history of highway improvement back of 1775, when Tresaguet, the famous French engineer, made known his method, has little more than a sentimental interest. To duplicate the massive Roman highways today would involve the use of an incredible amount of labor and material, the most of which would be wholly unnecessary. I should estimate that a Roman highway, such as the Appian Way, would cost today approximately $245,000 per mile. In this age of conservation of energy and materials, the massive ancient highways have no place.

Tresaguet, while Inspector General of the District of Limoges, presented a report to the Assembly of Roads and Bridges of Paris in 1775 in which he laid down the essentials of good highways as, first, adequate drainage; second, the reduction of the foundation to a single course of stone laid on edge on a subgrade crowned parallel to the finished surface; third, a single course of broken stone to cover the foundation to a thickness of about 6 ins., and, fourth, a system of continuous maintenance by regular employees. Out of the labors of Tresaguet grew the splendid road system of France, with its great organization of cantonniers for continuous systematic maintenance. About twenty-five years later, Telford, in England, announced a method of construction almost identical with that of Tresaguet, and about the same time McAdam introduced his method, which varied from that of Tresaguet by discarding the pitched foundation and using on the earth subgrade a single course of hand-broken stone. The methods followed by these three men continued without fundamental changes until practically the beginning of the twentieth century. The invention of the stone crusher by Blake in 1858 resulted in the very general abolition of hand labor for crushing stone, while the invention of the steam roller by Lemoine in 1859 marked another step toward the perfection of equipment and increase in efficiency of construction work. The McAdam method has been modified to the extent that the stone is now usually applied in courses and stone screenings are used as a binder. The advent of the automobile has, as you well know, served to revolutionize methods of construction and maintenance, and has given a new functional importance to the highway which has practically made it necessary for us to start into the twentieth century on a new basis.

From an administrative standpoint, the experience of European countries is valuable to us chiefly through its demonstration of the efficiency of a centralized and systematic supervision as compared with uncorrelated local supervision or with the management of the roads by private enterprise in the form of toll companies. The French system of highways affords us an example of efficient centralized management which cannot fail to prove of value in working out our own systems of management. Washington recommended in a letter to Patrick Henry that the roads of Virginia be taken away from the control of the county courts and be given to the state authorities. One of Hamilton's pet schemes was that of road improvement, and he recognized thoroughly that roads left to local authority would never be satisfactorily built. In a functional sense, the national roads of France were laid out before the advent of the railroad, and were designed to serve the purpose which, in later times, was served in that and other countries by the railroads. In other words, it has yet to be demonstrated that the highway may be considered in the class of the railroad as main trunk lines of traffic. Possibly if the French national highways had been laid out at the opening of the twentieth century instead of the nineteenth a different plan might have resulted. The French methods of construction prior to the general introduction of the automobile were the methods of McAdam and Tresaguet, so that France is having the same problem of adapting the roads to meet the new traffic conditions that confronts us in this country, except that her difficulties are greater by reason of the large mileage of roads built according to the old methods. The French system of management and maintenance, however, has resulted, through a long period of years, in keeping the French roads in first-class condition, and at less cost per mile than in England where the policy of extreme localization in road management has largely prevailed. Maintenance costs have increased so enormously in recent years that figures promulgated a few years back are of little value; but I should estimate that the general cost of maintenance in England has been at least 20 per cent. higher than the cost of maintenance in France, this difference being due largely to the difference in management.

Another lesson of importance in the history of highways abroad was the experience of England with the toll roads. During the first half of the nineteenth century the toll roads formed a perfect network throughout England, Scotland and Ireland, but they proved so costly in operation and so inefficient in results as to cause the most widespread dissatisfaction and opposition. By 1878 every toll road had been abolished in England, Scotland and Ireland.

Our own history of road management has been, for the most part, a repetition and an exaggeration of the poor local management which came to us as English precedent. The best evidence we have as to the inefficiency of extreme localization in road management is the fact that the only states which are really noted for their excellent highways are those in which the state government has provided a system of state highways. No doubt, mistakes have been made in state work, with considerable waste of state money through the influence of politics and faulty organization, but the fact remains that during the past twelve or fifteen years in which state aid has been a prominent factor the states of Massachusetts, Connecticut, New York, New Jersey, Maryland, Michigan, Wisconsin, Virginia, California, Washington and others have made greater progress than was made throughout their entire history prior to the adoption of the policy of state participation. We are spending at the present time upwards of a quarter of a billion dollars a year, and it is absolutely imperative that centralized and systematic control be provided if we are to avoid saddling posterity with a heavy debt for improvements which do not materialize.

The rapid development of the automobile and the concentration of approximately one-half our population in crowded cities are two factors which have made the problem of highway construction and maintenance difficult, intricate and of nation-wide importance. In the early days, when each farm or plantation was a community unto itself, the highway was a purely local convenience. Even in comparatively modern times, when large cities were few and far between, and when animal power limited the radius of traffic to 30 or 40 miles at the most for a day's journey, the roads were still of local importance primarily, although in a larger sense than in the Colonial days.

The automobile has tremendously increased the radius of travel. It has linked city and country together; it has made township and county and even state lines sentimental boundaries which have lost their economic importance. The crowding of millions of our people in cities has made the public highway in the most remote rural districts of vital importance to the cities, because the farmers must feed the cities. Parallel with this need of the city for the product of the country has come the need of the country dweller for the manufactured products of the city, and so there has been woven by the shuttle of mutual need in this wonderful age of invention and progress a network of interdependence in which the public highway has become an essential part of the very fabric of our social and industrial life.

Inseparably linked with these great functional problems of

the public highways are the physical problems which motor traffic and the movement of a vast tonnage of products to and from the centers of population have given rise. The growth of the motor vehicle industry has been not merely rapid, it has been stupendous. It seems but yesterday since the awkward one-cylinder cars drove frightened horses into the ditches, and yet today it is probably not overestimating to say that there are over two and one-quarter million automobiles in the United States. This phenomenal traffic came suddenly upon thousands of miles of water bound macadam and gravel roads which had been built to meet the older forms of traffic. The systems of maintenance in effect were inadequate and utterly broke down under this new burden. The result was that by the time legislatures awoke to the necessity of providing adequate money and organization, their roads had deteriorated to such an extent that in many cases resurfacing was necessary. Maintenance cost increased at an alarming rate. Where formerly $100 per mile was considered sufficient for a water bound macadam road, it quickly jumped to $250, then to $350, to $500 and $750, and in some states it has been estimated that $1,000 per mile per annum is necessary for maintenance. As a result of these startling changes for maintenance, a considerable degree of discouragement has arisen, for the taxpayer does not like to feel that he must not only spend a large sum of money for construction, but must thereafter put up from $500 to $1,000 a mile to keep his road in good condition. Right here let me emphasize the fact that these excessive costs are not strictly maintenance costs, but rather repair and reconstruction costs, as well as extraordinary maintenance due to tardiness in meeting the heavy traffic wear. Gradually we are adapting ourselves to the new conditions, and the result should be a considerable reduction in the cost of maintenance per mile. As an incident to the modern problem, brick, concrete, and improved bituminous surfaces have come into prominence. I will not undertake to enter into the discussion of the relative merits of each type of highways, but it must be generally recognized that we can no longer follow the short-sighted policy of building highways without consideration of the problem of maintenance. It is not so much what a highway costs today as what it will cost in the aggregate in ten years, or twenty years.

The basic proposition upon which our road building and maintenance in this country must ultimately rest is that the character of the road and the amount of money expended for its construction and maintenance must be determined by the service which the road renders. For example, it may be genuine economy to spend $20,000 on one road and only $2,000 on another road, because in the former case the ser-

vice rendered may be ten times the service rendered in the latter case. We have in this country some two and one-quarter million miles of road. We know that in every community, in every county, and in every state all traffic flows from feeders and little neighborhood roads into the main highways that lead to the markets and shipping points and connect the centers of population. It is a conservative estimate to say that these highways do not aggregate one-quarter of the total mileage. A great many million dollars of highway expenditures have been unproductive in this country through undue parsimony in the improvement of the main heavily traveled highways and lavish extravagance in the improvement of highways which have little or no economic importance.

The taxpayers should awaken to the full realization of the fact that the taxes which they pay into the public treasuries for public road improvement should in the interest of the taxpayers be subjected to the same sort of business management and business expediency that make for success in private enterprise. The average taxpayer pays his taxes and thereby relieves himself of what he considers a burden. He loses all interest in the further disposition of his tax money, except to complain from year to year of the small return which he has received for his outlay. Legislatures are supposed to be the servants of the people, and if the people who pay taxes insist that their legislatures provide for the management of the county's public works an adequate and responsible organization, and an intelligent system for the expenditure of road funds, the proper laws would be forthcoming and the wastefulness and inefficiency which has marked our previous experience in highway improvement would be largely corrected. Before undertaking any general scheme of improvement, it is the duty of the county to have traffic studies made of its roads, so as to determine the order and measure of their importance and the character of construction which should be adopted to meet the traffic requirements as indicated by such study. The tonnage and the average haul on each road afford a unit of measurement known as the ton-mile, and the total ton mileage, present and prospective, of the road will indicate its relative importance for modern purposes. This can well be done by ascertaining for each road the land area and the acreage yield of the zone from which it would draw its tonnage of freight traffic. When the relative importance of the road for the transportation of the farm products to the shipping point is known, the character and amount of the outgoing traffic on the road from the centers of population should be determined. The incoming and outgoing traffic will thus measure the market importance of the re-

spective highways. If the road is of importance for pleasure travel or is a link in an important through highway, a heavy expenditure for improvement may be justified aside from a local economic consideration, but certainly some such intelligent method would be infinitely preferable to the present method of laying out a system of roads that will reach all sections from a geographic standpoint and will provide a uniform construction regardless of the relative traffic importance of the roads to be improved. Aside from this intelligent selection of locations and types, I believe that there is a positive need for a centralized control and a highly skilled supervision on the part of an agency of the state, particularly with reference to the design and inspection of highway bridges, the expenditure of large local bond issues, the handling of local funds for highway work as to systems of accounting and cost keeping, and finally as to the qualifications of the men locally selected to carry on road work. The trend for the past ten years has been distinctly in these directions, and I believe that ultimately we shall have a compact and efficient county organization and compulsory selection and improvement of roads according to their traffic importance and finally correlation and executive and technical skill through the medium of a state supervision, such as I have just outlined.

In the financing of road improvement there is a growing tendency to rush hastily into debt through the issuance of long term bonds for the building of roads for which no adequate maintenance provision is made. These conditions are peculiar to county work rather than state work. The evils of long term bonds for short term utilities have been dealt with by many authorities on the subject, and I will only reiterate my belief that the solution of this problem will come through the placing of adequate power to supervise and regulate county bond issues in the hands of a centralized state highway department.

On the whole, great progress has been made in recent years from the construction standpoint, lesser progress in providing adequate maintenance, while the trend toward centralizing control of the more important feature of highway work is just now becoming noticeable in an encouraging degree.

CHAIRMAN PRATT: I want to announce that the committee on credentials will meet in Room 200, Hotel Oakland, at the close of this session, and I wish all the delegates would leave their credentials at the registration bureau so they can be collected and referred to the committee on credentials.

Is there any discussion on this paper by Mr. Page? We

have got a limited amount of time that has been allotted for discussion of these several papers. Any one who wishes to can take part in the discussion of Mr. Page's paper.

There is just one point I would like to bring out in connection with that, because it has been one that has been affecting us in North Carolina to a considerable degree, and that is the question of making provision for the maintenance of the roads after they have been constructed. We have been working on and expect to pass at the next session of our General Assembly a law that will prohibit any county, township or the state from issuing bonds for the construction of roads unless a law authorizing the issue of the bonds contains a clause or section that will mean the upkeep and maintenance of those roads after they are constructed. We believe that law will be passed. Several of the bills that were passed by the recent general assembly pertaining to the authorization of bonds contain such a clause. The counties issuing the bonds make it obligatory upon the commissioners that they shall levy a sufficient tax to give them money enough to maintain the roads after they are built, and that money cannot be used for any other purpose. If it is used for any other purpose the commissioners are liable for the amount. Is there no discussion on this paper?

C. A. KENYON (Indiana): That is such an important thing that I would like to make one remark, more in the form of inquiry than discussion. I have frequently had county officers inquire how we can provide for maintenance not only for this year but for next year and the year after. We are officers to-day. We are providing for the highway. We are willing to provide for it next year, but we are out of office next year and new officers are in. They pledge to their constituents economy and they say we can't go any farther. Therefore we want to provide for an amount which the engineers think necessary to keep up these roads. The result is that the roads, because of this peculiar system, go into decay. What legal means can you use to force future action of county commissioners and others to make a levy to take care of those roads?

MR. ROY (Washington): In our state at the last meeting of our general assembly we made the same levy as we did for the preceding year, but we provided in that law five per cent. for permanent highways should be set aside for maintenance; for the public highway seven and one-half per cent. should be set aside for maintenance; and at the next general assembly we hope to raise that to ten per cent., to take care of the coming needs of the roads constructed a number of years before.

CHAIRMAN PRATT: Is there any further discussion?

W. H. REED: Of course there is the danger of a lack of maintenance of roads if it is not provided for in advance, but as an offset to that there is always the pressure of the public that is using the roads. If the roads are in bad condition the public is sure to come before the county commissioners and call their attention to the horrible condition of those roads. If those men are to maintain their offices that pressure will be sufficient to care for the maintenance. On this paper which has just been read I was struck with the point that was made of the importance of not giving a large amount of money without knowing where it is going. The tendency in road building is first to determine what type of road shall be built. After determining that you must decide whether you will build that type on trunk lines and everywhere. The tendency with politicians representing a certain district is to put as much money into their particular district as possible. That does not represent the county. That is the serious hardship.

CHAIRMAN PRATT: Any other discussion? We have a minute or two.

A. D. GASH: On this question of maintenance I would like to speak for just a moment. In Illinois we provide for state aid. The state aid for building the main thoroughfares is for fifteen per cent. of the mileage in counties of the first class, twenty per cent. in counties of the second class, and twenty-five per cent. in counties of the third class. These are called state aid roads. They are laid in all the counties and are built with funds one-half from the state and one-half from the county. It is designed to have main thoroughfares connecting all of the trading points of the state and reaching within four miles and a half of every home. Thirty per cent. of our citizens reside on the highway and when these thoroughfares are completed seventy-five per cent. will reside within one mile and along the highway. Section thirty-two of the law, and I believe it is one of the best laws that has been passed in any of the states of the United States, provides that when these roads are once constructed at the expense of the county and the state, that the state will forever maintain them. Now it is of course certain that the present legislature can't provide the means for all time, but it is the intention of the law and it is, as I take it, a compact between the various counties and the state when once the county has put in its one-half that the state legislature will provide the means for keeping these roads up when they are once constructed in a permanent manner, keeping them up to the highest standard after they are once constructed in the various counties. I believe that that is the best method of maintenance—to have an understanding between the counties that go in on

the construction. The last legislature provided that the various counties may bond the counties and build the roads under the supervision of the state highway commission and according to their plans and specifications, and the state may then take those roads over and forever maintain them and their part of the apportionment of the aid money may go to retire the bonds. It might be well on that point of maintenance to look at the Illinois law because it is a good one.

LAMAR COBB (Arizona): Mr. Chairman, I think we are seeking the will-o'-the-wisp when we are seeking some law that will compel maintenance. The only solution of that question is the education of the people as to their necessity. Those in charge of highway improvement should furnish the people with more data relative to the proposed cost of maintenance. In the past I don't believe that the highway authorities in the states have furnished the public with sufficient information on the cost of maintenance. The reason I say I think we are seeking the will-o'-the-wisp is because some roads improved by a bond issue will last fifty or a hundred years and there is no possible way of providing a law that a legislative body has got to provide funds to maintain those roads. As I say, the only possible way is to keep impressing upon the public the necessity for maintenance and advising them of the cost of such maintenance. (Applause.)

CHAIRMAN PRATT: The next subject we will take up is "The Relation of the Road to Rail and Water Transportation." This subject is to be discussed by Mr. C. J. Tilden, Professor of Civil Engineering, Johns Hopkins University.

The Relation of the Road to Rail and Water Transportation

By C. J. TILDEN

Professor of Civil Engineering, Johns Hopkins University

The rapid growth, in recent years, of the automobile industry, has concentrated attention on so-called pleasure traffic, and the public demand, so far as highways are concerned, has been most insistent for roads especially constructed to serve this new form of pleasure and excitement. The call is not only for hard roads, they must be smooth and dustless as well, and, even more important, must furnish long distance routings and permit of rapid travel between widely separated cities and towns. It might seem, sometimes, that the more modest service road, with no pretensions to the development of speed and seeking only to help in the never-ending task of bringing that which men need in daily life from the source to the point of consumption, is not getting its share of attention. There is nothing incon-

sistent, however, in developing highway systems for both purposes, and often one road may and does serve both ends.

The necessity of a highway system, or at least a series of roads in connection with any system of transportation by rail or water or both, is too obvious to need discussion. The great importance of this relationship, however, is ample excuse for giving it at least brief consideration. Especially since the motor car has come into use in rural communities, the roads to and from railroad centers and canal stops must be harder and better built, and this means, of course, cheaper transportation to and from the main lines of traffic. Furthermore, better roads mean greater speed as well as carrying power both for motor vehicles and those drawn by horses, and the roads may therefore be longer, thus making more distant localities available for profitable production. A railroad without highways to serve it might as well run through the desert, and the better these service roads are the richer is the community and the better able it is to serve those who use its products.

The experiments in highway building which the national government and various state highway departments are trying, and the many demonstrations they are making of different kinds of construction, furnish most valuable information to any locality in need of roads. This information is generally available in such excellent shape that there is little excuse for poor roads in any public-spirited community. The main thing is to find that type of road which fits not only the needs but resources of the particular community, then build the roads well and maintain them with due care.

There is, however, one other point in regard to building roads that are to be primarily a part of a general transportation system, which is perhaps worthy of note. A railroad is a private corporation, built to make money and pay dividends on the investment. The actual acres of land forming the right of way as well as the track, rolling stock and other material are all private property. On the other hand, highways are, with very few exceptions in the United States, public property, built with public funds and maintained at public expense by means of some form of direct or indirect taxation. The individual user of a road does not pay any direct fee, other than general taxes, for that use. What he does pay is not in the nature of a tariff on the amount and frequency of his shipments, as is the case with his payments to the railway companies, but may bear no relation whatever to his use, as a shipper, of the highway facilities. There is thus a fundamental difference between the economic foundation of a railway line and the economic foundation of the road or system of roads which is needed to serve that railway.

Whether or not this situation has any serious effect on the proper and normal development of a general transportation system would seem to be an economic rather than an engineering question. Certainly the writer does not feel competent to offer any solution of the problem. But this simple statement of the situation is made in the belief that further discussion may be desirable, and that any system of transportation should be planned and developed in its entirety rather than piecemeal in order to give the highest value at once to the localities it is designed to serve.

CHAIRMAN PRATT: The next subject is "The Benefits and Burdens of Better Roads," by Mr. S. E. Bradt, Secretary of the State Highway Commission of Illinois.

S. E. BRADT: Mr. Chairman and Ladies and Gentlemen: I think I am safe in saying that some phase of this subject which has been assigned to me is discussed in every speech that is made, every article that is printed on the subject of good roads, and I guess I could go further and say in almost every conversation, and yet it seems to be a burning question. It seems to be of greater importance and of greater interest from day to day and you all realize it is too large to be discussed in one paper even of this thickness.

The Benefits and Burdens of Better Roads

By S. E. BRADT

Secretary, Illinois State Highway Commission.

Without doubt, the great majority of the people are in favor of better roads; the disagreement comes when they consider the degree of betterment, which is the determining factor in the amount of the burden it will impose upon the community. It is my purpose in this paper to show that if we have the correct type of road construction and if the cost is properly distributed, the burden will rest lightly upon all and will be small in comparison to the benefits.

Good Roads the Concern of All

Road improvement is fundamentally an economic problem and affects either directly or indirectly our entire citizenship, regardless of whether its members live in the country, the town or the crowded city; regardless of whether they drive a pleasure car, a lumber wagon, or walk the streets of the tenement district. The greatest direct benefits will come to the users of the road; but in each instance there are indirect benefits reaching a greater number of people, and hence of greater importance finally than the direct benefits.

For our purpose we will classify the users of the road as follows:

I. The Farmer:
   (a) in hauling his surplus products to the shipping point, or direct to the consumer. (This traffic at the present time is largely horse-drawn, but, with a better road system, will gradually change to motor-driven.)
   (b) in carrying his children to school, his family to church or to the city entertainment.

II. The Lumberman or the Mine Owner:
   (a) in hauling his product to the shipping point.
   (This traffic is decreasing, as competition forces the elimination of the expense of hauling by bringing the railroad nearer.)

III. The Business Man:
   (a) in saving his time.
   (b) in lessening upkeep.
   (This traffic is now largely motor-driven.)

IV. The Tourist:
   interpreted here to mean all travellers for recreation, whether to the adjacent town or across the continent.
   (This traffic is mainly motor-driven.)

Let us look at some of the benefits to these four classes more in detail, and also note some of their indirect influences:

I and II—Benefit to the Farmer, Lumberman and Mine Owner in Hauling Products

The entire surplus production of the farm and many of the products of the forest and mine must first be hauled over our country roads to the shipping point. The Office of Public Roads estimates the cost of this hauling at not less than $500,000,000 annually. It further estimates that improved roads would reduce this cost one-half; which would result in a saving of $250,000,000 annually.

Indirect Gain to All People.—While this gain of $250,000,000 would be a direct benefit to the farmer, the lumberman and the mine owner, it would be an indirect gain to the entire people. The carrying of these products to the shipping point is as much a factor in distribution as is carrying it from the shipping point to the consumer. The people are quick to recognize that any increase in freight rates means an increase in the price of commodities, but have failed to realize that the cost of hauling to the railway station is equally a factor in their cost and hence in the cost of living. Freight rates have been reduced since 1837 nearly 90 per cent., but during that time there has been practically no reduction in the cost of highway transportation. The reason for this is that railroads have been constructed and operated from the standpoint of paying interest and dividends, which has

forced systematic and economic management; whereas our highways, because of our failure to appreciate their economic importance, have been neglected and the limited amount of work expended upon them has been unsystemmatic, uneconomical and without satisfactory returns.

Benefit to City Residents.—An indirect benefit of no small consequence accrues hereby to the resident of the city in the delivery of the products of the farm and truck garden direct from producer to consumer. This means not only more palatable food, but food that is more sanitary as well.

Benefit to the Farmer's Family Educationally.—The inaccessibility of the country school for several months of the year due to impassable roads is one of the great drawbacks to country life. Another drawback is the small school district supported by a few farmers and with a small number of children and a small assessed valuation from which to collect taxes for its support. This results in a low salaried teacher, conducting a poor school with poorer surroundings.

Consolidated School.—The solution of this problem lies in the consolidated rural school, specializing in the agricultural branches which will give the pupils an insight into the problems of the farm and inspire them with the wonderful opportunity for the improvement of farm life, financially, socially and mentally. Better roads will mean more consolidated schools and larger units of consolidation which will give more funds and greater school facilities, or will mean access to the city schools without leaving the farm.

Social Advantages.—Again, the farmer will receive a direct benefit from good roads in the increase of social and religious advantages. The lack of these is felt most keenly by the wife and children and is often the determining factor in the decision of the boy and the girl to leave the farm. This is traceable directly to road conditions which generally keep them at home for several months during the winter and spring, and can be overcome only through improving the roads so that the country church and the city entertainments are accessible at all seasons.

Dependence Upon Farmer.—Both educationally and socially the farmer would receive the greatest direct advantage from road improvement, but it must be remembered that no one class of our citizens can improve themselves financially, educationally, socially or religiously without indirectly benefiting every other class of our citizens. This is doubly true of the farmer. People have lived without the merchant, the manufacturer or the banker and could do so again, but the failure of the farmer to produce his annual crop would mean starvation. A partial failure would mean higher prices and unsatisfied hunger for some. As popula-

tion increases we must have a constantly increasing food supply. Adding to the educational and social advantages of farm life means more attractive farms, more farmers, greater efficiency, as well as more permanency in production, a larger and hence a cheaper food supply.

Improved Surroundings.—Outside of the tangible benefits to the farmer already enumerated there are others not so evident. As a man tears down the old house and builds in its place a modern one, not that he will make money by the transaction but that he will add to the comfort, the pleasure and satisfaction of himself and his family, so will he for the same reason advocate and stand ready to pay his share of the cost of a better road. The better road and the automobile combined with the modern house, the telephone and the free delivery of mail, the consolidated school, the resuscitated country church, will make the farm home an attractive place for the boy and the girl, for the father and mother. This combination will not only check the farm to city movement, but will make the "back to the farm movement" a practical possibility.

III—The Business Man

We have considered the benefit to the farmer, the lumberman and the mine owner as users of the road. Now let us look at the benefit to the business man from the same standpoint. In these days we have come to measure distance more by minutes and hours than by miles. The saving of time to the business man is often the difference between success and failure. In this saving of time the automobile is one of his most useful agents, and the better the road the greater is its usefulness to him.

IV—The Tourist

The benefit of road improvement to the tourist as a user of the road is self-evident; and to attract and hold the tourist we must have good roads. We have the expanse of territory, the scenic effects and the historic spots. We lack only the improved roads to make this country the mecca for the tourists of the world.

The indirect benefit of this traffic to the United States is the expenditure of millions of dollars at home rather than in foreign countries.

The Automobile Owner.—To convey some idea of the direct benefit of improved roads to automobile owners I would call attention to the fact that there are over 2,000,000 automobiles in use in the United States today and they are being manufactured at the rate of over 500,000 annually. It is a conservative estimate to say that a system of improved roads would mean a saving to the owners in tires, repairs, and gasoline of not less than $50 per car per year, or a total of $100,000,000 annually on the cars now in use.

Let us summarize some of the benefits. Better roads will mean: Better farmers, greater farm efficiency, less tenancy, larger production, higher land values, cheaper distribution, cheaper commodities, purer milk, fresher vegetables, less gasoline, less tire trouble, better rural schools, better school attendance, better social conditions, better rural churches, more attractive rural homes, more boys staying on the farm, more girls marrying farmer boys, more sociability, better citizenship.

For the business man they will mean more time for work and more time for play with lessened expense in maintaining his machine; and for the tourist more places of beauty and historic interest to visit and greater comfort in visiting them.

The Burdens of Better Roads

The question now arises, are the benefits worth the cost? Fortunately, the answer to this question has not been left to us. The American people have already answered it in the affirmative. The people as a whole stand for progress and without doubt road improvement is to be one of the greatest factors in national progress. In some sections of the country, however, owing to the fact that local legislation fails to place the burden of taxation in the proper place, or does not afford proper facilities for the equitable financing of the burden, the work is advancing slowly.

In discussing the burdens I shall consider: 1, the size of the burdens; 2, who shall carry them? 3, how can they be carried?

Mileage to Be Improved.—We have in the United States approximately 2,200,000 miles of highways. By relocation and eliminating the unnecessary sections this would be easily reduced to less than 2,000,000 miles. Of this 2,000,000 miles some 240,000 are already improved, leaving 1,760,000 miles to be improved.

Cost Depending on Conditions.—What it will cost to improve this 1,760,000 miles depends chiefly upon the type. This in turn should be determined by the amount and kind of traffic. Investigation has shown that 20 per cent. of our roads carry approximately 80 per cent. of the traffic. It, therefore, follows that this 20 per cent. should be built of a more permanent, hence more costly type, than the remaining 80 per cent. It is also true that there is a large variation of traffic on the different sections of this 20 per cent. of the system, which would mean a considerable variation in type and width, hence in cost of construction. From the foregoing it will be seen that to determine the cost of a system of roads over a given area, there should be a study of the local conditions in each section of the area. This survey should include a count showing the number and kind

of vehicles with approximate loads, the population of the tributary territory, the industries of the locality and available road building material. I have no knowledge of any large section where such a survey has been made, and, hence, in order to give any figures that would indicate the approximate burdens of better roads, it is necessary to rely upon estimates.

Illinois as An Illustration.—For this purpose I shall take the State of Illinois. Many of the states having state aid in road work have laid out a system of through routes, and main market roads comprising from 10 to 20 per cent. of their total mileage. Illinois has such a system which includes about 16,000 miles (17 per cent. of the total 94,000 miles). Local officials report that of the 94,000 miles 9,000 are improved. We will assume that 3,000 miles of the improved roads are included in our state aid system of 16,000 miles, thus leaving still to be improved 13,000 miles of the said system. Our estimate of the cost of improving this 13,000 miles is as follows:

3000	miles	@	$15,000	$45,000,000
6000	"	@	10,000	60,000,000
4000	"	@	6,000	24,000,000
				$129,000,000

Cost to Taxpayer.—As before stated, the different estimates of costs arise from different widths of the roads as well as different types of construction, depending upon traffic, and are purely estimates, as we have taken no traffic census. There will be a variation both as to the number of miles in each class and the cost, but we assume that the entire system can be adequately improved within the estimate. This sum of $129,000,000 spread over a period of 20 years would require $6,450,000 annually. On the assumption that the average equalized assessed valuation for the state for the next 20 years will amount to $3,000,000,000, the above $6,450,000 would cost the taxpayer an average of 21½ cts. per $100 of assessed valuation. This would mean that the man owning a home valued at $1,500, assessed at $500, would pay $1.07 per year.

Cost to Farmer.—Under our state aid system by which the state and the county each pay one-half the cost of the state aid roads, the farms of the state on the average pay 40 per cent. of the cost of the improvement, the balance of 60 per cent. being paid by personal property, cities, villages and corporations. Forty per cent. of the $6,450,000 required annually would be $2,580,000, which would be the proportion paid by the farmers. This, divided among the 34,000,000 acres of farm land in Illinois, would mean a cost of 7 cts. per acre annually for a period of 20 years to the farms of Illinois for the improvement of this system of

13,000 miles of roads. This is assuming that all of the money is provided by a direct tax with no assistance from any special tax, or from the federal government. Even on this basis the burden when spread over the entire state, is small.

Improvement of Connecting Roads.—You will say that we have provided for only 20 per cent. of our mileage, which is true; but we have provided for 80 per cent. of the traffic. Further, our townships are levying at this time a tax from which they realize over $7,000,000 annually which will be applied to the improvement of the remaining 80 per cent. of the roads. Again, inasmuch as these roads receive only 20 per cent. of the traffic, it follows that they should be improved at a very much less cost per mile, and that upon a large part of the mileage, because of light traffic, the economical type of construction will be a well graded and drained earth road with systematic dragging. Illinois with a little less than the average of improved roads should be fairly typical of the general average.

Distribution of Burden.—Another feature that has a very important bearing upon this question of how burdensome the cost of better roads will prove to be is the matter of its distribution among the different taxing bodies.

Burden Concern of All.—We have shown that road improvement is no longer a matter of purely local concern, but of benefit to all. It is also evident from all the estimates of cost given for Illinois that the cost in the aggregate involves a sum comparable only to the cost of our railway systems, from which it follows that we must have assistance from all possible sources. These sources are: The federal government, which derives its income mainly from customs and internal revenue, thus drawing indirectly from all classes; the state tax, reaching all property within the state and including all the large cities and corporations, as well as many fees and special taxes; the county and township taxes, more localized in their scope and nearer the source of the benefits; and in addition to the above the automobile and kindred license fees, collected from a certain part of those benefited. All of these channels are utilized at the present time except that no aid is received from the federal government.

Federal Aid.—If our statement is true that all the people are benefited by good roads, then all the people should share the burdens. There are in the United States many millions of people who pay no town, county or state taxes, and who can only aid in this work through indirect taxes which they pay to the federal government. Hence only through federal aid can these millions be called upon to share their part of the burden.

The government has in recent years taken a considerable amount from the revenue contributed at home and expended it in improving the highway systems of Cuba and our island possessions, but has steadfastly declined to assist in improving the roads at home. It is committed to the principle of aiding and fostering internal improvements along other lines, having expended many millions for public buildings, rivers and harbors and other similar improvements. It has even gone to the extent of purchasing foreign territory for the purpose of constructing a world water-way upon which it has expended 300 to 350 millions of dollars. Many of these improvements were needed, and all are beneficial to a restricted number of people, but no one will say that these benefits are at all comparable to the benefits which would have been derived from the expenditure of an equal amount of money in road improvement. That this same amount of money would reach a vastly greater number of people and cause a much greater development of the resources of the country, if expended on roads, does not admit of successful contradiction.

Roads Important to National Defense.—To look at the matter of federal aid from another standpoint, we hear much in these days about our lack of preparedness for defense, in the case of attack, and the indications are that public sentiment favors the strengthening of our army and navy and our coast defense; but no preparation for defense will be complete without the proper improvement of our highways.

The war now in progress is a conflict in which the machinery of war is playing the most important part; and no part of the machinery is more important in its general utility than the motor-driven vehicle. As an illustration of the part it is taking, I would call attention to the fact that in the year ending June 1 we shipped to Europe 13,432 trucks, saying nothing of the unfilled orders, and that we are now sending to the war zone an average of over 100 trucks per day. Trucks without roads would be useless. And if the government is to prepare any adequate plans for defense it cannot overlook the improvement of our highways.

Amount of Federal Aid.—The extent to which the government should assist in road improvement should be commensurate with the importance of the project and with the amount of money required to carry it on. We are now expending annually over $200,000,000. It would appear that assistance to the extent of $50,000,000 would not be out of place. We have been expending about that amount annually on the Panama Canal, which is now completed. This amount of money could be profitably expended in furthering road development. Whether the government shall

construct a system of government roads, or assist the states in the improvement of rural mail routes is not so important, as enlisting the government in the work. The economic advantages undoubtedly lie in a cooperation of the state and federal departments; but it is not my purpose to discuss this matter.

Cost, How Provided.—The next question that arises is: How shall the money be raised? Shall we proceed on the "pay as you go" plan, or shall we borrow the money? I have shown that to build these roads over a period of 20 to 25 years would not be burdensome to the people, but public sentiment is rapidly working toward the point of demanding immediate improvement of a fair proportion of this mileage, especially the main roads. In other words, they want them now. There can be no argument against the "pay as you go" system if you have the money, or are willing to wait for the improvement until you can raise the money; but if you haven't the money and do not want to wait you will be obliged to borrow.

Issuing Bonds.—There are certain rules which should govern in issuing bonds for road improvement.

1. Bonds should not be issued so as to place any burden upon the future taxpayer for which he does not receive full value.

2. Bonds should be issued to mature serially.

Under these rules it follows that bonds should not be issued for temporary work. It also follows that the durability of the improvement should be one of the important factors in determining the rapidity with which the bonds should be retired.

The issuing of bonds maturing serially has the advantage of avoiding the necessity for providing a sinking fund to retire them at some future date; and what is equally important, the taxpayer is paying for the improvement at the same time that he is wearing it out. Under these rules paying for road improvements through the issuing of bonds is the most equitable system of financing. As an illustration, instead of paying this year the entire cost of improving a small piece of road, would it not be better to use the same amount of money in paying one installment upon the cost of improving the entire road? In the first instance, the community would pay the entire cost of the small part and drive through the mud on the balance of the road; while in the second instance they would have the entire road improved, and the taxpayers using the road each year thereafter would pay a share of the cost.

Automobile License Fees.—Another source of revenue for road construction and maintenance outside of taxation and bond issues is the automobile and kindred license fees. These

fees are reaching as much as a million dollars annually in some states and are a decided help in carrying on the work. They are paid very willingly by owners of automobiles when the money is being economically used in improving the highways.

Economy and Efficiency in Construction.—Finally, the burdens will be materially decreased by a careful, systematic and economic expenditure of the people's money. Not only that, but the people will cheerfully pay for improvements that give them value received. In many states we are still struggling with the small unit of control which is sure to give unsystematic work and uneconomic results. Only to the extent that road construction is systematized and connected from the state department to the district organization, with trained and efficient road builders in charge, will we be able to give to the people the proper returns for the money expended.

Conclusion.—I have already summarized the benefits to be derived from better roads. I have endeavored to show that, while the burden is large in the aggregate, if properly distributed over a series of years, it will be comparatively small to each individual, and that the direct saving through the use of the road over a period of years will pay for the improvement; that the federal government should join with the state, the county, and the township in carrying this burden; that the issuance of bonds for this improvement is equitable if under proper restrictions; that we should conserve all road funds by systematic work under competent direction.

A prominent writer has said that the era just passed is the "steam age" and that we are now entering the "gasoline age," also that the "steam age" is responsible for the development of the great railway systems of the country and that the "gasoline age" will bring about a like development of the highways; further that the result of the "steam age" has been the concentration of the people as well as capital in large centers, whereas the tendency of the "gasoline age," both as to people and capital, will be from the city toward the country. This statement is unquestioned as regards the past and its prophecy as to the future is in harmony with the trend of the times.

CHAIRMAN PRATT: Is there any discussion on this paper? If not, the next subject for discussion is "Roadside Improvement," and the discussion will be led by Mr. Henry S. Graves, Chief of the Bureau of Forestry, United States Department of Agriculture. I have been informed that he has been unavoidably delayed and cannot be here. He has sent here a paper which will be published in the proceedings, but it is not on this subject. It is not on the subject of

"Roadside Improvements," but "Road Building in the National Forests." At the end of the papers of this afternoon's session if any one wants to call up that subject we can take it up for general discussion.

Road-Building in the National Forests

By HENRY S. GRAVES

Chief, Bureau of Forestry, U. S. Department of Agriculture

There are one hundred and fifty-nine national forests in the continental United States, with a net area of 136,000,000 acres. With few exceptions, these areas are grouped along the axes of the Rocky Mountains, the Sierra Nevadas and the Coast Range, and along certain outlying groups in the Great Basin and spurs from the main ridges. Because of their physical location the national forests present serious problems in transportation and communication. They contain the highest altitudes and the roughest topography in the United States. Large areas are still entirely without roads of any description and, until the Forest Service took up their administration, were not even provided with trails.

Within the boundaries of the national forests are numerous mining camps, small agricultural communities and isolated farms. Some means of access to outside markets and to sources of supply has been imperative. Individuals and communities have constructed roads when possible, but when the cost of even makeshift roads was too great to be borne, trails have had to suffice. Earlier settlement was upon the most accessible lands; future settlement will be upon more remote areas. The lack of transportation facilities will consequently become more acute, and the need for an adequate system of roads will constantly become more urgent.

On account of the lack of transportation facilities, the Forest Service on assuming administration of the national forests was obliged to incur considerable expense in constructing roads and trails for purposes of administration and protection. Out of the appropriations for permanent improvements some 2,000 miles of road have been constructed or repaired at an expenditure of about $400,000, and over 22,000 miles of trails have been built at a cost of over $1,000,000. Although under the terms of the appropriations acts these roads and trails have been built primarily for purposes of administration and of protection, they have also been of material service to the general public.

Recognizing that the national forests should contribute directly to community development and to the maintenance of local public institutions, Congress in 1906 passed an act under the terms of which 10 per cent. of the receipts of each national forest should be paid to the state in which such forest was situated, to be expended as the Legislature might

prescribe for the benefit of the public schools and public roads of the county or counties in which the national forest was situated. In 1908 the amount was increased to 25 per cent. Including the present fiscal year, the total thus paid to the states for road and school purposes will have aggregated nearly $4,500,000. Only a very small part of this, however, has ever been used for road building within the national forests. The settlers within national forest boundaries form too small a minority in county affairs.

At the beginning of 1912 Congress appropriated a further 10 per cent. of the receipts to be used solely for the construction and maintenance of roads and trails within the national forests, such roads to be primarily for public use and the moneys to be expended under the supervision of the Secretary of Agriculture. Whenever practicable, the cooperation of state and local agencies was to be secured. It is under this law that the Forest Service has organized and is carrying on construction of public roads within the national forests.

The field force of the Forest Service is organized into six districts. By a cooperative agreement with the Office of Public Roads and Rural Engineering a roads engineer has been detailed to each district and has charge, under the direct supervision of the District Forester, of the location and construction of roads within the district. Including the present fiscal year $926,000 has been appropriated, and $526,000 has been expended for the construction, repair and maintenance of some 500 miles of road. The remaining $400,000 has been or will be allotted for use during the current year.

Before proceeding with construction, the Forest Service made extensive reconnaissance surveys for the purpose of classifying the road projects in each state in the order of their relative importance. This procedure was necessary because the need and the demand for road construction funds have been many times the appropriations available. It has been the aim of the Forest Service to concentrate its funds on a few projects and to carry them rapidly to completion rather than to scatter its efforts over many projects with indifferent results. In the selection of projects for construction, preference is given to those sections and communities within or adjacent to national forests that are situated away from the main systems of state or county highways and that would remain without means of transportation were it not for the assistance of the Forest Service.

No attempt has been made, or is likely to be made in the future, to construct expensive, surfaced roads. Transportation conditions within the national forests would not warrant the expenditure. It is the aim, however, to build good quality, medium width earth roads with easy grades and

adequate drainage. In several instances, on account of heavy rock excavation, it has been deemed advisable to build at present only a single track road, but with provision for frequent turnouts and so located that the width can be readily increased in the future if conditions warrant. Particular emphasis is being placed on grade and drainage. Wherever reasonably possible, 6 per cent is the limiting grade. Side ditching is universal; protection ditches are built wherever required, and culverts of ample size are placed at frequent intervals. The Forest Service proposes also to devote a portion of its funds each year to the maintenance of the roads already built. Ditches and culverts will be kept open, and the roads will be dragged and crowned whenever necessary. In many instances a small crew will be kept constantly at work during the open season until the road has become thoroughly solidified under traffic.

The funds available will build only a small part of the roads that are needed; the remainder must be built by the local communities or remain unbuilt unless some new plan for road financing is adopted. Under such conditions, the importance as object lessons of a few well-built and well-kept roads is apparent. It is the aim to build a class of roads that should be within the means of the local communities to build for themselves, and particularly to prove by example the advisability of protecting the original investment in road construction by reasonable annual maintenance. The mountain communities, especially, need proof that intelligent maintenance of earth roads is cheaper than intermittent repairs.

By taking advantage of an existing organization and of the Forest Supervisor's intimate knowledge of local labor conditions, it has been possible to construct roads by direct supervision at a less cost than by contract and at a considerably less cost than similar roads have been built in the past. On account of the moderate cost and the satisfactory character of the roads which are being built, cooperative funds supplied by individuals, associations and local governmental agencies are in the majority of cases turned over to the Forest Service to be expended under its supervision. At the close of construction, a detailed accounting of the entire expenditure is submitted to the cooperators. No work that the Forest Service has undertaken has met with more hearty commendation or received more generous local cooperation.

There are at present 24 road projects under construction in 12 states. Among those already completed, several are worthy of special mention. The road over which for years all traffic was carried on between the Big Hole Basin, in Beaverhead County, Montana, and the Bitterroot Valley,

crossed the Continental Divide at an elevation of about 7,000 ft. On the Big Hole side the road was located for several miles up a swampy creek-bottom, completely submerged at high water, and difficult of passage at all times. On the abrupt descent on the Bitterroot side the road dropped nearly 2,000 ft. in a distance of 3 miles. It was narrow, scoured by every rain, and had grades in excess of 25 per cent. Every load going over the grade had to be broken at the foot of the ascent. In cooperation with Ravalli and Beaverhead Counties and with local residents, the Forest Service made a complete relocation and constructed 26 miles of new road on firm ground, with a limiting grade of 6 per cent. at a cost of $51,000, of which $32,000 was paid by the Forest Service, $13,000 by Ravalli and Beaverhead Counties, and $6,000 was raised by private subscription. This road gives to a large section of Southwestern Montana access to the Bitterroot Valley, forms a section of the "Park to Park Highway," is suitable for all forms of travel, and provides for through freighting without the necessity of breaking loads.

Work has just been completed on the Troy-Libby Road, in Western Montana, forming the closing link in a through road down the Kootenai Canyon from the upper Flathead Valley to Spokane and the Inland Empire territory. A road now under construction in Northern Idaho will complete through connections between Sandpoint, Idaho, and the International Boundary. A road has been completed across the Ochoco National Forest, in Oregon, forming a connection between Prineville and the orchard country of the upper John Day Valley, and another road under construction across McKenzie Pass will become the main route from the upper Willamette Valley across the Cascades into Eastern Oregon.

On the Idaho-Wyoming boundary a road is being built over the Teton Pass to furnish an outlet from Jackson Hole and the upper Snake River Valley to the railroad terminus at Victor, Idaho. The road across the Rabbit Ear Pass, on the Routt National Forest in Colorado, will be completed this season. This road, together with one already built across the Cochetopa Pass, will open up large sections of national forest in Colorado to freighting and to tourist travel. A road just finished in the Powell National Forest, in Utah, will open communication with a settlement in a valley of the Upper Colorado that has hitherto been practically shut off from the rest of the world.

At the present time there is no road open the year through, or one suitable for freighting, between the Northern California coast and that portion of the Sacramento Valley north of Red Bluff. The available funds in California are to be

concentrated in large part upon a section of road down the Trinity River, through the Trinity National Forest, which will, when completed, furnish a through route, open at all seasons, with a grade not to exceed 6 per cent. between Redding and Weaverville on the east to Humboldt Bay on the Pacific Coast.

While the Forest Service is doing all that is possible with the funds under its administration, the amount available is insufficient even to keep pace with the annual increase in demand due to increase of settlement. In many national forests the cost of an adequate system of roads is far beyond any means at present available for their construction. There are large areas where means of communication are either primitive or nonexistent. Not only should the existing settlers be given access to markets, but new agricultural and mining districts should be opened up; timber resources should be made available, and all the vast recreation possibilities of the national forests should be made accessible to the general public. Yet to really open to their full use such forests as the Selway and Clearwater, in Idaho, the Olympic in Washington, and the Klamath and Trinity in California, would require the expenditure of hundreds of thousands of dollars. Whence shall these funds come? The local communities cannot possibly supply them, or any appreciable part of them.

No better example can be given of the conditions that exist in many districts than that of Trinity County, California. With an area which is 2 per cent. of the entire state, its assessed valuation is less than one-tenth of one per cent. of the total state valuation. With a tax rate the highest of any county in the state, the total county receipts in 1914 were less than $80,000. The highest road tax permitted under the law would yield but $18,000 a year for the maintenance and repair of 23 bridges, 375 miles of road, and 450 miles of trail—an amount entirely inadequate for the purpose, even if no new construction were attempted. An adequate road system for Trinity County would cost not less than a quarter of a million dollars. Obviously, the county is utterly incapable of raising this amount.

Fifty-eight per cent. of the area of the county is national forest land; less than one per cent. is arable valley land. It is sometimes argued that all these problems would be solved if the public land were permitted to pass into private ownership, and the example of eastern states is cited as a proof of the contention. Yet one need only to observe the condition of roads in the Appalachian Mountains where the land has been in private ownership for generations to realize that something more is needed than the ability to tax non-producing timber land before any reasonably adequate system of

roads can be built in sparsely settled mountain territory. If the lands within the national forests were like those of the Mississippi Valley or of the Atlantic Coastal Plain, the argument might be valid, but they are not. Agricultural lands are confined to narrow valleys along the streams. Such areas as are susceptible of cultivation are being opened to settlement as fast as there is any demand, but the greater part of the national forest lands will forever remain unsettled—suitable for nothing else than the growth of timber.

There are on the Olympic Peninsula in the State of Washington millions of acres of virgin timber in private ownership being held unused for future rise in prices. If private ownership is all that is required, the Olympic counties should not lack road facilities, at least in those districts where private ownership obtains, and yet those very districts of huge private timber-holdings are almost as devoid of roads as the primeval wilderness. Private ownership of timber lands has discouraged settlement; taxable values are low, and it will be necessary for the state to provide roads which shall connect the west coast of the Olympic Peninsula with the Puget Sound district.

There is no reason to assume that private ownership of public timber lands in Trinity County would result any differently than it has on the Olympic Peninsula or that it would to any appreciable degree solve the road problem of that county. What, then, is the answer? Within Trinity County are fourteen billion feet of national forest timber, worth, at a stumpage value of only $2 per thousand, $28,000,000. Under present conditions of transportation and of market, this value is only potential. If protected from fire and other destructive agencies, these timber lands will yield annually and forever from one hundred to one hundred and fifty million feet of timber. The return to the county from a rational development of the timber sale business will be slow, but it will be sure. Although at the present time the returns to the county through the 25 per cent. of net receipts are very small, within the next 20 years it should be sufficient to meet all needs. But the present is unprovided for, because the timber is now inaccessible and unmarketable. Some plan should be adopted whereby the enormous potential values in unused timber resources should serve as the security upon which funds may be obtained for immediate use.

The present plan should be modified in order to make these heavily timbered forests serviceable to the people at the present time, during the most serious pioneer stage of the region's development. Where existing resources justify it and the public need can be shown, future receipts should be anticipated and advances be made by Congress for the construction of roads, bridges, and similar public works;

these advances to be returned to the Treasury from the sums which will be received later and which would go to the communities under the present law. In application there need be no general legislation nor any general appropriation, but every project should be taken separately and on its merits. In every case a separate development unit should be considered; a plan of needed road development should be worked out by the government and county officials in cooperation; a specific plan should be determined for those improvements immediately needed; a statement should be prepared by the Forest Service showing the timber and other resources and the receipts that can conservatively be guaranteed as soon as those resources can be realized upon; a full showing should be made of the need of the improvement and of the direct public service which would be rendered in the development of agriculture, mining, or other resources within and without that forest. In short, a business statement should be prepared for each given project separately, which would demonstrate its desirability and soundness from the standpoint both of local benefit and of public finance. Inasmuch as every advance would be secured by existing resources now owned by the Government, there would be no possibility of loss. Also, as every advance would be returned from the share of later receipts already pledged to the communities by Congress, there would be no question of a federal grant. The first direct proposals to Congress should be in the form of small advances for surveys which would be used as a basis for specific estimates for later advances which Congress would fully investigate before making the money available.

The proposed plan would make public benefits of the national forest immediately realizable; it would accomplish a development not possible for the communities without public aid; it would relieve the burden of taxation on struggling new communities; it would hasten the development of the national forests themselves which are unavailable because of lack of transportation, and every expenditure would be guaranteed by resources now controlled by the Government, so that in the long run there would be no net contribution by the nation itself except as provided by existing law.

Clearing of land for farming, building of homes and schools and churches, public improvements of towns, in addition to road building, are the burdens of a small struggling population composed largely of men possessed of great perseverance and courage, but of little means. It should be a fundamental principle that the national forests are not to be regarded as a separate federal domain administered only from a national standpoint and without reference to the needs of the local communities. The forests were set aside to

accomplish a great national purpose, but their first and greatest service should be to the local communities.

CHAIRMAN PRATT: "The Essentials of Proper Laws for Highway Work" is the subject of a paper which has been prepared by Col. E. A. Stevens, State Commissioner of Public Roads in New Jersey. The discussion of this paper was prepared by Mr. A. N. Johnson, of the Bureau of Municipal Research of New York City. These papers are here, and if at the end of the other papers anyone wishes to have them read we can have them read from the platform, and we can then have them discussed.

The next subject is a rather broad one, "National, State and Local Responsibility for Road Conditions and Ways of Securing Improvements." I will call first for the discussion of this paper, on Judge J. T. Ronald of Seattle, Washington, if the Judge is here. Apparently he is not here, and I will now call on Mr. O. E. Hotle of Oakland, California. Apparently he is not here. Is the Hon. Arthur Langath of Portland, Oregon, here? Is there anyone here who would like to discuss this particular subject, "National, State and Local Responsibility for Road Conditions and Ways of Securing Improvements." As I stated it is a pretty broad subject. You can bring into the discussion of this subject almost any phase of road work, and it was under this head that it was expected we would take up something in regard to federal aid. I am going to ask Mr. MacKenzie, if he is in the room, to take up the discussion of this paper.

C. L. MAC KENZIE: Mr. Chairman and Gentlemen: I have prepared a paper for presentation to the Tri-State Good Roads Association on the subject of "Federal Aid to Rural Districts."

CHAIRMAN PRATT: Can't you give that paper here?

MR. MAC KENZIE: I was requested by Major Crosby, the chairman of your program committee, to present it here. We adjourned our meeting to this body. However, I didn't bring my paper with me, but I have sent to the hotel for it and I would be glad to read it to the association if it gets here in time. It is not here yet, but will be probably in five or ten minutes. I would prefer to present it through the paper rather than through an address, if you can arrange it that way.

CHAIRMAN PRATT: We can arrange it all right. With the permission of the delegates we will go back to the fifth subject, "The Essentials of Proper Laws for Highway Work." Does anyone want to discuss that subject?

MR. COBB: I would suggest, Mr. Chairman, that Colonel Stevens' paper and Mr. Johnson's paper be read.

CHAIRMAN PRATT: I will ask Mr. Cobb to come up

on the platform and read Colonel Stevens' paper. (Laughter.)

The Essentials of Proper Laws for Highway Work

By COL. E. A. STEVENS,
State Commissioner of Public Roads of New Jersey.

I shall at the outset, assume that improved public roads are a commercial necessity and that the benefits of improvement will repay any reasonable cost. Those who differ with me on this point will continue to do so until the inexorable logic of the law of the survival of the fittest shall have demonstrated their mistake.

Granted that we must have good roads and that these are to be obtained through legislation, we face certain difficulties which need careful consideration before an attempt is made to decide on the exact character of legislation needed. These difficulties spring partly from our national character, our political conditions, the traffic on our roads and the extent of our road problem.

We are by nature optimists and perhaps unreasonably hopeful. We cherish and perpetuate many of the traits springing from the pioneer work done by our immediate forebears. We are too apt to undervalue the need and value of specialized training and consider that any industrious and sound person can successfully tackle work with which he has little or no experience. We believe a little too much in the Jack of all trades and this seems to be especially true of our roads. Whatever may have been the fact in the days of dirt roads and animal haulage, we have progressed far beyond that point today. We ar too great believers in the gospel of "hustling" and but too apt to forget the homely wisdom of Davy Crockett, "Be sure you are right and then go ahead."

Our political conditions and predilections incline us to glorify and exalt the benefits of checks and safeguards and of local self-government. I am far from decrying this as a general doctrine, but it is to be borne in mind that any governmental unit to which special work is to be intrusted should, from its capacity and powers, be fitted for the performance of the duties imposed, and that, if we are to have good roads, we must commit their administration to a body fitted to discharge the duty, irrespective of our theories as to the desirability and extent of local self-government.

The experience of such states as Massachusetts, Rhode Island, Connecticut and New Jersey, which some years ago took up the question of road improvement and which have made progress therein, proves that the motor vehicle traffic, developed by this work far exceeds that which should have

been expected under European conditions. While this demonstrates the greater importance of the highway under American conditions, it also vastly increases the difficulties of the problems involved in the proper construction, repair and general administration of our road systems.

Our problem considered as a national one is so big that its very extent is hard to realize; nevertheless it is certain that we shall in the near future build a very large improved road mileage; that the cost, for the country at large, will greatly exceed that of any public improvement which we have ever tackled, not excepting the Panama Canal, and that this large sum of money will come out of the public purse and be expended through public officials, and that, through such expenditure, if wisely made, an important commercial advantage will ensue, not only to our agricultural interests, but to our industrial development. The cost, however, will be so great that, however it may be met, it will prove a serious tax upon the funds which the nation can spare for public improvements. Every delay in the completion of our road system will mean a loss due to the prolongation of conditions that are already a serious tax on many communities, as witnessed by the abandoned farms and deserted fields but too common a sight in our older states. It is, therefore, of double importance that the public should receive the full value of every dollar expended in the work; in other words, that in planning our legislation we should keep in mind that the administration must be efficient. Any clog or hindrance unnecessarily imposed by legislation will prove a source of expense and delay. Road law should be simple, clear and elastic. Nothing will prove more harmful than unnecessary profusion of details, superfluous and useless checks and safeguards, or the enactment into statute law of engineering formulae. We have, I repeat, a difficult task. For its proper performance we need thorough preparation.

Legislation must be drawn with this end in view. The work to be done must be carefully planned. The people are entitled to know at the earliest possible moment the kind and extent of road system that it is proposed to provide; its probable cost; that provision has been made to meet this cost, and that the roads to be built will be maintained so as to yield the benefit of the investment which it is proposed to make. In other words, the road system must be planned and the probable cost of both construction and maintenance carefully estimated at the very outset and this work should be provided for by law. Only when the data thus obtained are available can a businesslike financial plan be formulated. Nothing is so demoralizing to the force and hindering to the consummation of a road building program as the voting of

some odd millions of a bond issue to be spent on a system of roads, as yet unlocated, as to the cost of which it is impossible to formulate an intelligent guess and for whose maintenance in condition to render the service for which they were designed no provision has been made. The carrying into effect of any carefully planned system will depend on the means provided to meet the most of the work. When these are dependent from year to year on the whim of legislative bodies and the demands of other public works, the difficulties of efficient administration are multiplied. When to the uncertainty as to the amount of funds available, there are added limitations of the amounts available to the certain branches of work, the difficulties in the way of efficient administration become insuperable. Any more wasteful expenditure than the forced construction of new roads when sufficient repair funds for those already built are lacking is hard to imagine.

When a state enters into an arrangement to have the road work done by its political subdivisions there must arise complications that will endanger efficiency. It must be borne in mind, in considering this matter, that results similar to those obtained in such states as I have above named are to be expected, with such variations as are due to local conditions, in other and less thickly settled states. It is beyond question that, in a country without improved roads, present highway traffic forms no basis on which the traffic after future improvement can be estimated. Not only will lands which have hitherto not repaid the cost of cultivation become productive, but the character and amount of crops raised, of manufactures produced and of supplies needed, will change. Traffic will flow in other lines; owing to the reduction in the cost of highway transport the distance which various commodities can be carried will materially increase; shipping points heretofore impossible will become available. All of this will be governed by the law of demand and supply whose results are largely dependent on the cost of transportation.

It is essential that a decision should be reached early in the consideration of the subject as to the public bodies to be placed in charge of the different classes of highways. Streets in thickly inhabited towns, it seems generally admitted, not only in this country, but in Europe, should be under the care of the municipal corporations. This seems the best practice.

As to the administration of country roads, as distinguished from streets, it seems wise to divide these into classes, according to their importance and to devolve the care of the various classes upon different governmental bodies. The difference in organization in the various states would neces-

sarily enter into consideration of this subject. The present tendency seems to be to have the state take over the control of the most important roads and to turn over those of lesser importance to county or town authorities or, in some cases, to subdivide these lesser roads into two classes, one of these to be cared for by the county and the other by the town or township. The plan of allowing the local bodies such as the towns in New England and the counties in the southern states, full care and jurisdiction over all public roads seems to have been found wanting. Whatever provision is adopted, the roads will form one system, traffic will pass over the lesser to the greater and back again and the full usefulness of the system can only be realized by insuring that all parts shall be maintained in a condition of efficiency; in other words, good road service will require cooperation between the public bodies and officials on whom will rest the duty of improvement or maintenance. I believe that all who have had experience on the subject will agree with me that this cooperation cannot be left to the haphazard agreement of the parties in control and that means must be provided to secure the much needed concert of action.

Our predilection for checks and safeguards is but too apt to carry us to extremes in the enactment into law of details that should be left to executive discretion. Carelessness and haste in legislative consideration but too often results in needless and vexing confusion. The absence however, of provisions for detail implies and must rest on confidence in those to whose discretion matters of importance will be left. To provide not only a head but the force through whom he must act, to insure that in character and attainments they shall hold and enjoy such confidence and be able to maintain their right thereto, is by no means the least important feature of an ideal road law.

In the manning of the road force it is essential that the properly qualified individuals should be chosen. Selection cannot be made on the basis of partisan politics. The "esprit du corps" of the force cannot be maintained unless there be a permanency of tenure and unless faithful and successful work will bring promotion and advancement. These rules should be applied to all road organizations, whether they be state, county or town. The work will be a large one but in each of its subdivisions there must be some one assigned to every specific duty, provided with the reasonable necessary means of performing the same and held to a strict accountability therefor.

The exact form of organization chosen does not seem a matter of great importance, provided the principle of responsibility is not overlooked. Sinecures are not only wasteful, but demoralizing. The whole force knows at an early date

whether or not the boss (or the three bosses, if such be the case) are "on the job." The organization must be worthy of public confidence and of its own. If it has this, if it takes pride in its work and in its record, it becomes a living force that can overcome physical and legislative difficulties and do its work with other objects than quitting time and pay day in sight. Without such a force, the best devised forms of organization will be but poor substitutes. Not only as a measure of efficiency, but as an incentive to such a spirit does the need of a thorough and efficient system of records and accounts become indispensable. I may be pardoned for dwelling on this subject.

However we may disguise it, the cost of a road is made up of three parts: First, the interest on the original cost of construction, including the value of the right of way, design, engineering, etc.; second, the annual repair or upkeep charge, and, third, the making good of the deterioration in the structure due to defects that cannot be remedied as quickly as they arrive, and this figure should include the allowance for obsolescence. All of these items may not show up in the yearly tax bill, but somehow or other they will come out of the pocket of the public, whether contributed as taxes on property or so-called license fees on vehicles.

The motor vehicle itself has completely upset the methods of carrying highway traffic and road conditions in general, but not only as to types of design and construction. The methods of administration to meet the conditions thus created must be subject to change. In the State of New Jersey in ten years the motor traffic has increased something like twelvefold. It is, therefore, clear that sufficient time has not elapsed to make the imperfect statistical data of the past of great value in laying out the work of the future. It must be borne in mind, too, that the best data available, the French, is based upon a motor vehicle population of about .4 of a vehicle per mile of road, whereas in New Jersey, in 1915, this population will probably exceed 5 vehicles per mile. Statistics as to the performance of and cost of maintenance of road surfaces under the tests of actually known traffic intensities are the only data on which design and systems of maintenance can be scientifically based. The gathering of such data is generally beyond the power and financial ability of the smaller communities and should be provided for by the general government or the various states. It is always hard to persuade the Legislature of the necessity of spending money for information, but the necessity exists and must be recognized if we are to have efficiency. The weights carried over a road system and speed at which they are handled for a given cost are the measure of the return. The determination of a unit to express this value is by no

means easy and involves accounting and statistical work of no mean character, yet the reduction of the cost of this unit will be the consideration which will influence the flow and amount of highway traffic. In the case of a railroad, the direct cost of hauling and those charges necessary for the maintenance and upkeep of the permanent way are all paid from the same pocket and can all be easily referred to the unit of ton or train mile. In the case of the highway, however, the cost haulage will be borne by unknown private individuals, while the cost of maintaining the permanent way will be paid out of the public pocket. Good roads will reduce the cost of haulage, increase traffic speeds and the cost of road maintenance and reduce the total cost enormously.

The problem is thus a complicated one when viewed as a general economic proposition. The need, however, of an accurate knowledge of the cost of providing good roads referred to a unit expressing the value of the return yielded is by no means lessened by such complication. In no other way can those responsible for the proper and wise expenditure of road moneys satisfactorily plan the work and in no other way can the results obtained be fairly judged. A cheap construction may well be justified, in spite of high repair cost, by low interest and depreciation charges.

I have above alluded to the need of forecasting the cost of road work and of providing the means of meeting the same, also of the division of the total cost of road transport between the public and the vehicle owner. These subjects bear on the determination of how the moneys needed for road work are to be raised. Bonds are merely means of anticipating revenues to be received in the future; if use is to be made of them the fund necessary to meet them at maturity must be provided, but without endangering the availability of a sufficient repair fund or the depreciation charges necessary to care for those parts of the work that will call for periodic renewal. The cost of providing road service is today a heavy charge on many communities. The value thereof accrues to the road user, to the adjoining property, to the locality, to the state and to the nation at large. An equitable division of the burden is of vital importance, but in such division the interest on the cost of construction must be borne in mind.

I cannot close in any better way than by summing up into a few conclusions the needed features of a road law:

1. The language must be clear.

2. A system of administration must be chosen and, whether responsibility be centralized or distributed, it must be clearly devolved on the agency chosen.

3. A careful preparatory study of the work should be pro-

vided for and determination based thereon of the program and of the means set aside to meet the cost of the same.

4. The organization provided must be fit for its work and worthy of confidence not only in its character but in its ability.

5. It must be given adequate powers and means.

6. It must render full account of its work.

The Essentials of Proper Laws for Highway Work

Discussion by A. N. JOHNSON,
Highway Engineer, Bureau of Municipal Research, New York, N. Y.

Road legislation is to be regarded as the rules and regulations by which the construction and maintenance of highways are to be carried on. They provide for the organization, defining the officials and their powers and duties, the procedure to be followed, the sources of revenue and its distribution, together with regulative acts regarding the use of the roads and punishments for violations. This paper necessarily can touch upon one or two points only, and those but briefly.

Logically Arranged Road Laws Lacking.—Few states have passed a general highway law which has been considered as a whole and therefore has a logical arrangement. The nearest approach to such are the highway laws for New York and Illinois.

In general, the highway laws of the various states have been developed by piecemeal; amendment added to amendment, laws repealed and the repealing act itself repealed, until amongst the bewildering mass of words it is hard to distinguish who is in authority in a given instance or what the procedure should be to accomplish a certain purpose.

To add to the confusion the statutes are full of special laws to enable particular ends to be gained, many states having special road laws for each county, with the general laws of the state applying in so far as they do not conflict with the county laws.

Comprehensive Re-enactment of Road Law Desirable.—Thus in nearly every state much would be gained by comprehensive re-enactment of the road laws of the state, arranging them in logical manner and repealing all existing laws in order to avoid conflicts.

But more than a mere rearrangement is necessary if road legislation is to be had that will meet modern needs.

A highway law for a state should be passed that has been so carefully considered as to make it wholly unnecessary for the legislature each year or two to tack on additions or make vital changes. Such a highway law should provide for a

proper organization, one that would give sufficient power to a central authority to promulgate by rules and regulations much that is now detailed legislation.

Continuity of Policy Desirable.—Such authority should be placed with the State Highway Department whose organization, to be effective, must be such as to secure continuity of policy and employment and retention of trained highway engineers. They must be free from the political football game. Skilled technical men and not political manipulators thinly disguised under the term of "practical men," must be in control.

The state department as here contemplated is to have more than the control of merely a restricted system of state roads. It is to have general control of all the road work and the road policy of the state.

If any proof is needed that such central control is essential and that present road administrative methods are totally unable to meet modern needs it is only necessary to glance at most of the special legislation for local road projects.

Local Road Administration Ineffective.—The many special laws for the expenditure of bond issues indicate clearly the appreciation of the inadequacy of the usual road machinery to carry out effectively road improvement on the scale that is demanded today. The question that arises is to what extent have the devices that have been substituted for the regularly organized road administrative methods remedied the defects? Do these special road laws and bond issues provide a satisfactory solution?

Local Bond Issues.—During the past ten or fifteen years a noticeable feature of road legislation has been the provisions that have been made for road work to be paid for by local bond issues. There are few states where legislation of this character has not been passed. The reasons leading up to such legislation, which has involved in the aggregate hundreds of millions of dollars in bond issues, is manifestly to be ascribed to the great public interest and desire for improved roads.

Attempt to Provide for Skilled Supervision.—The provisions that are made for an organization to carry out the work are significant. In a majority of cases a special board of commissioners is created and complete organization provided; in others, while the regular officials may have general control, they must employ an engineer or skilled superintendent. In every instance an attempt is made to remedy the defects of the usual road machinery by which no skilled supervision is provided, and which it is realized is necessary when the proposition is to spend a comparatively large sum of money on few miles of road.

This class of legislation includes the provisions for the establishment of special road districts and organizations to spend particular bond issues. They vary from a road system for a county to the formation of a restricted district for the improvement of but a single road. Usually the work to be done and the amount of money to be spent are submitted for approval to the electors resident within the area from which the funds are to be raised, many laws providing that only voters who are property taxpayers are entitled to vote.

Organization Provided Usually Short-Lived.—The organization provided by most of these laws exists only during the period of construction. Thus the skilled control which these special laws secure in a varying degree, at most extends but a short period.

Beyond providing means for raising revenue and the machinery for expending the same, little or no thought has been given them. No provision is made for continuing maintenance. No fixed income is provided on which to make plans for future work. No definite information is collected on which to base estimates for such an income. Long-term bonds are thoughtlessly voted for short-lived structures. The simplest fundamental economic principles are violated without giving them a thought.

To be sure, the selection of roads to be improved is generally good in so far as they are roads locally well traveled. This is more apt to be true in those cases where the road district is of considerable area than where the proposition is for the improvement of but a single stretch of road, in which case it frequently happens that many in a community not immediately concerned in the road in question are taxed for a portion of its cost.

It is to be seen that grave defects exist. Due to the temporary character of the organization brought into existence little or no study can be made of the situation, and what is most serious no adequate provision is made for the upkeep of the roads that are constructed. These special roads are usually of quite a different type of construction from the ordinary roads of the neighborhood but are nevertheless turned over to the care of local road officials.

Road Development Requires Broad Study.—Proper road development today requires the careful consideration of economic conditions over a comparatively wide area. There must be a careful study made to secure a road system such as will, when completed, meet the traffic needs and for the construction of which a carefully considered plan for the distribution of cost has been worked out.

The spasmodic and localized road improvement attempts can fit into such a scheme only by accident. Sometimes the

wrong road is chosen; other times it is not properly dimensioned; but in any event little or no thought is given to the part the road will play in a comprehensive road development plan.

More often error is found in the type of construction selected. With so many kinds of construction, each calling for special materials, all of which are actively advertised, the result frequently is the adoption of a type of pavement which represents not what is best for the road but what company employed the most persuasive salesman.

Bad Engineering Practices.—It might be thought that as most of these laws usually provide for the employment of an engineer supposed to be skilled in road construction, there could be no serious blunder made as to the type or manner of building the road.

Due however to the essentially temporary character of the employment afforded and to a lack of understanding in the minds of the people generally as to the necessity for securing high grade service, there have arisen practices by which apparently some small saving is made but which prove most wasteful.

The shrewd, careful men usually selected to have administrative control of these special road enterprises have had no experience whatever in road construction work and believe they pursue a very commendable course when they auction off the engineering, giving it to the engineer who will take the job for the least money. This short-sighted policy, saving perhaps a few hundred dollars, costs the taxpayers paying for the special work many thousands of dollars through the honest but misguided management of the men selected to safeguard their interests.

The selection of the proper type of road is far more of a scientific problem today than it was twenty years ago. The changed traffic conditions which make it difficult to select the type of road, make it also impossible when determining the roads to be improved, to consider but a small area.

Conclusions.—It is evident that if a locality is to bond itself for road construction the greatest benefit can accrue to such locality only if it chooses wisely both as to the location and the character of the work to be done. These questions require broad experience, and local effort has not been equal to the task. There must be provided by the state a department capable to advise and direct localities and with authority to prevent unwise expenditures as well as to supervise necessary improvements.

If the proper administrative methods are to be made possible there must be abolished a vast number of small independent units which now exist, with their horde of minor officials selected by ballot.

In general there must be reposed in a central state department power to make rules and regulations which now constitute a great bulk of legislative enactment, too often the results of trading and political expediency.

The central authority should be charged with the development of policies for the expenditure of all road revenues. Such a department to be effective must be freed from political manipulation and skilled men retained in control so that a continuing policy may be possible.

Road work is no longer a neighborhood concern and can not successfully be so administered but must be controlled by a properly organized, strong central authority.

CHAIRMAN PRATT: Is there any discussion on this paper? If not we will go to the sixth subject, and Mr. C. L. MacKenzie, who is connected with the Tri-State Good Roads Association, will read a paper that relates to the first phase of that subject, the "National Responsibility," in other words, the question of federal aid. (Applause.)

MR. MACKENZIE: I am sorry to state that I am not an officer of the Tri-State Good Roads Association, but am affiliated with that body, as I am the President of the Washington State Good Roads Association. This paper that I have was prepared hastily by myself with the expectation of delivering it before the Tri-State Good Roads Association, but I was requested by Major Crosby to give it to you and I will proceed to discuss the question as outlined by your chairman.

Federal Aid to Rural Districts

By C. L. MacKENZIE

President, Washington State Good Roads Association

It is an inspiration to those of us who have the road question at heart to participate in the deliberations of such a body as this. Your sincere and earnest attention to the discussions that have taken place here and your interested participation in the deliberations of this body, prove to me that the road question means more in a material and financial sense to the people of these United States than any question before them at the present time, grape juice and gunpowder notwithstanding, and our meeting here should result in great good to every community represented.

It is always a pleasure to be in California, in any capacity. The hand shake from your native son warms the cockles of one's heart and brings the joy of living home to one in the fullest sense. You feel more friendly toward the world as

soon as you get on California soil. Your hospitality, your kindness and your welcome, make us feel indeed that San Francisco, your exposition city, is the grandest city in the universe and I believe I am only echoing the sentiment of everyone here when I say that we appreciate more than we can express the many kind things that have been said to us and done for us since we arrived within the confines of your commonwealth. California climate is an asset, her golden grains, her luscious fruits and her nuggets of gold are assets, but above all these, as a halo of glory, is the kindness and the hospitality of her people, and we of Washington are glad indeed that we can claim neighborship on the north and bask thereby in the sunlight of your reflected glory.

I wish here to say, that in the development of our road system, every road points toward your golden shores. The highways that we have built, and the highways that we are going to build in the future, are investments that we are making, to bring the greatest returns to those who will use them; to the traveling public, and to the tourist. And what richer harvest could he make than the views he would see, the inspiration he would gain and the rest and pleasure he would receive from a trip starting with the mysteries of the famous Yellowstone, across our state, past majestic Mount Rainier, down the beautiful Columbia River, along the shores of the boundless Pacific Ocean to the glad land of California where the sun ever shines and where the milk of human kindness ever flows free.

A little word of advertising for our own state and for our Highway Department. We are spending in our state seven or eight million dollars a year for roads. This program has been followed faithfully for the past three years and we hope to follow it for twenty more. The following figures are furnished me by James Allen, chief engineer of our highway department, showing in a definite way what we are doing:

Expenditures, State Highway Fund and Permanent Highway Fund, from April 1, 1913, to April 1, 1915, $4,442,262.00. Mileage constructed during same period, 576; State road mileage under contract, August 19, 1915, 300; permanent highways under contract August 1, 1915, 197 miles. Total contract price, $1,219,256.00. Total road mileage in State, approximately, 37,000, divided about as follows:

Unimproved earth roads	24,050
Plank and corduroy	200
Improved earth roads	8,500
Graveled roads	3,700
Pavements	550

Total appropriation for State Road construction, 1915-16, $2,230,925.00.

Total appropriation for Permanent Highway construction, 1915-16, $4,000,000.00.

Funds for the construction of state roads are raised by a general tax of one mill, yielding about $1,030,000 per year. Funds for the construction of permanent highways are raised by a general tax of one and one-half mills, and amount to $1,500,000. Besides this we expended county road funds during 1914 as follows:

Road and Bridge Funds	$2,345,535.00
Road District Funds	3,113,595.00

Or a total of a little over $8,000,000 for the year.

Bond Issue, 1914-1915:

King County	$3,000,000
Clallam County	300,000
Skamania County	210,000
Wahkiakum County	75,000

This year finishes our first improved highway, connecting the eastern and western portions of the state. In my county, the county of Whitman, and in the neighboring county of Spokane, our present mileage of improved highways, over those of three years ago, show an increase of one thousand per cent. Ninety-five per cent. of all this work is paid for as it is done, our plan being a public highway tax spent under the direction of the state highway commission and a permanent highway tax spent by the county commissioners, cooperating with the state highway commission. We claim that we are in the front rank of road building states, and that per capita, we are spending as much, if not more than any other state in the union, for the purpose of building improved highways.

There are many reasons why this is so. Washington is a state of many and varied resources, all of a staple character. We farm, we mine coal, we produce lumber and we produce fish and all in quantities that compare favorably with the production of any other state. My county, the county of Whitman, is purely an agricultural county and was fourth in the United States last year in the production of agricultural products. Our citizenship is of a high type, aggressive and highminded, and believe in good roads and believe in getting them now, during our life time, when we are at an age when we can enjoy them. Another reason why we are making such wonderful progress in the building of improved highways is that we have as a citizen of our state the man whom I believe today is the foremost road builder in the world, a man who has just celebrated his fortieth year in the road building movement. He has spent over half a million dollars of his own personal funds in the furthering

of our worthy cause. He has vitalized the movement for improved highways in our state for the past fifteen years. His ideas at present are the prevailing ones in the improved highway work in our neighboring state of Oregon. He is the active spirit, the originator of, and the man behind the gun on the Pacific Highway, an improved road now under construction from Alaska to Mexico. I refer to Mr. Samuel Hill of Maryhill, Washington, and our kindest word is the testimonial we offer him.

In discussing "Federal Aid to Rural Districts," I am going to assume that the topic means financial aid from federal funds, and it is a paradox that this question was to be the one suggested as a topic for discussion by myself, before your honorable body, because you are supposed to boost the proposition, if you live in the country as I do, but I have always opposed the federal government going directly into the road building game. I believe in the most miles of public highway, and in the highest type of their improvement. I believe in getting the most miles of good highway by any means available, by accepting free aid in their development and building, in prodding the local taxpayer for money with which to build them. Yet I do not think I am in favor of the federal government going directly into the road building game, outside of the National Park roads, as I have always been afraid it would create an immense "pork barrel," if the federal government appropriated large sums for the direct building of roads, and under the "pork barrel" system they are inclined to build roads for political needs, or for any other service than that of serving traffic. We have had many road fights in our state over the location of state highways and their underlying cause was usually some politician trying to steal the bacon. A politician would have it here or there, or anywhere where it would please the most voters, irrespective of the traffic needs, or of the geography of the country. There are politicians who would run a road over a seventy degree hill, if each degree gave him a vote. All of the bills now before congress, and there are a mass of them, carry immense sums of money for the development of our highways. I will not go into an analysis of any of them now, as money spending is their main feature, the method only differing.

I look upon the building of our highways in the nature of an economic problem. I look upon it as a problem to be met and solved by the people of the community where the road is to be built. Ninety per cent. of the traffic over all roads is the local traffic, then why shouldn't the local man originate the improvement. In my county the question of improved highways presents itself to me, and to all those

who think of improved highways, as an economic necessity. Our county was fourth, as I have told you, last year in the production of agricultural products among the counties of the United States. We will produce this year fifteen million bushels of grain. This grain is handled in sacks and we have had for twenty years a fixed price for the hauling of this crop. It gives us one cent per mile per sack, 20 cents per ton per mile to haul our grain to the shipping point. Fifteen million bushels of grain mean 7,500,000 sacks. A one mile haul would cost $75,000, and a six mile haul, which is the average haul in our county, would cost six times that, or $450,000, the annual traffic charge against our grain crop for hauling from the farm to the shipping point. Now, with improved highways and auto trucks, loads could be doubled and quadrupled and the hauling hours be lengthened to twenty-four and, without a question of doubt, the cost of hauling could be cut squarely in two. This thought alone in these days of close figuring on costs makes good roads an economic necessity, leaving out all of the other factors of pleasure, accessibility to towns and schools, ease of horses, etc.

The sentiment for good roads is now general in every community and the improved roads are being produced just as fast, if not faster, than the development of types. In my opinion, forty per cent. of the money appropriated for good roads at the present time is wasted. Roads costing ten thousand dollars per mile are being built wholesale, that go to pieces the first year. A type of road, the road that gives value received for the money expended is not nearly as easy to furnish as the money to build it with, and the development of types is not nearly keeping pace with the feverish desire to build. A federal road fund, or "pork barrel" for road politicians, would build extravagant roads where they are not needed and in my opinion work against the real interests of the good roads movement. Very often under these conditions, the type selected would be one that pleased the contractor, rather than the taxpayer. A federal fund for disbursement for improved highways would mean state against state, county against county, town against town and the politicians running off with the road while the real users were fighting. The farmer is a factor in the business of this country, and the volume of his business and his personality are sufficient factors to handle the road question in any rural district, when the farmer is properly educated and his energies pointed in the right direction.

Our property value in the United States at the present time runs in the neighborhood of one hundred and forty billion dollars and the property value of the farmer, or the value of all farm property in the United States at the present

time will run between forty and fifty billion dollars, about one-third of our national worth. His gross returns from this investment is between nine and ten billion dollars per year, a return of twenty to twenty-five per cent. a return equaled by no other line of business in the United States. It is true that the farmer is the great producer of this country, and the city the great consumer. A great majority of those who live in the city are engaged in the consumption, manipulation and distribution of the products of the farm. Cut off the production of the farm and the city would be denuded of the greater part of its population. Half of the ten billion dollars that the farmer gets for his yearly crop goes for the expense of distribution. One-half of the remainder goes for the expense of production, which leaves two and a half billion dollars, net, as a yearly return, or better than five per cent. on a forty billion dollar valuation for his property. It is true that the farmer furnishes most of the traffic. Fifty per cent. of the one million, seven hundred fifty thousand automobiles in the United States are owned by farmers.

So I say that the volume of his business, his prosperity and the fact that he is largely caring for his own traffic justifies one in the conclusion that the local man should be asked to pay the big end of the consideration for a road in a rural district. My idea is that the desire for the improvement of any highway should start from where it is going to be and be had by those who are going to use it. Only those people endure who work out their own destiny, and the man who will not do his part in the building of highways that will put three cents a bushel on the price for his grain, move his home half way to town, nearer schools and to the comforts of civilization, is not worthy of consideration in connection with the road problem.

Now, I live in a farming community. Nearly all my friends are farmers. Nearly all my business relations are with farmers and I know that the farmer will do his share and will not shirk in the building of these rural highways, once they get the proper viewpoint as to the desirability and necessity of their improvement. The farmer today represents the greatest dynamic force that this country possesses. As an element of aggressive force in our business life, in defending our country in time of need, or supporting our governmental action in any line, or in cultivating his own development, his natural force is a powerful machine. Some time he lacks a steering wheel and this is what the good roads man can furnish. Putting the energies of the people who live in our rural districts back of our road movement will give us better roads and more roads for less money in less time than any other system. The financing should be divided and ap-

portioned, first to those who own property in the immediate district to be served by the road when it is built; second, by the county, or collective users; third, by the state, and fourth, by the federal government. And the federal government in extending aid should recognize no smaller political body than the state and act with and through the various state highway commissions.

This is practically our present method. The money the government has put into the building of roads is an infinitesimal sum compared to the sum that is being spent each year within our borders by states and counties, and the good road movement has prospered beyond the wildest dreams in the past thirty years. Each year sees our mileage of improved highways nearly doubled and our present system must be a good one, as it brings each year in the increased yearly development of highways its own proof of efficiency. Why? Because the people are back of the proposition of good roads and participating in it and the burden of building is kept close to them and they realize that they must rely on themselves rather than some fellow three thousand miles away.

What has been the history of our good roads movement in relation to its support by the Federal Government? In 1806 our government made its first appropriation for improved highways. This act provided for a highway from the Atlantic Ocean to the Mississippi River. For thirty-two years this work received the attention and appropriations of our government. The final appropriation for the development of this road came in 1832 and it totaled up to that time fourteen million dollars and this total sum created a road that existed only in Ohio, Pennsylvania, Virginia and Maryland, an extreme mileage of possibly three hundred miles. Government money ceased to come for the building of public roads in 1862 and until July, 1892, improved highways were forgotten. The germ that inoculated this country with the good roads fever and which has developed until it reaches into every section, was the lowly bicycle. In 1892 it appeared and with its appearance came agitation for good roads. The bicycle furnished but the inoculation. The real fever was brought on by the worthy successor of the bicycle, the automobile. There is nothing that brings the temperature of any individual to the boiling point in the matter of good roads, more than a brand-new, shining, up-to-date automobile, and his enthusiasm never wanes after he has purchased one until a good road is started somewhere in his neighborhood. In March, 1893, the Office of Road Inquiry was established as a department under the Secretary of Agriculture, the appropriation that year for the support of this office being the magnificent sum of ten thousand dollars. This office has been

continued up to the present time, its title, however, now being the Office of Public Roads. The annual appropriation for this office has been increased from time to time, but the direct appropriation for its support has never exceeded the sum of $300,000 per year. This amount does not include the $500,000 per year appropriated for the improvement and development of post roads by Congress in its Act of August, 1912, a supervision of the expenditure of which money comes under the Office of Public Roads. There were two hundred and seventy-nine employes in the Office of Public Roads at Washington, D. C., last year, the work of the Government Bureau being purely educational. The following statement about covers their work:

"Communities interested in the improvement of roads are recommended by the United States Department of Agriculture to apply for a lecturer on the subject. Lecturers will be sent at the government's expense wherever there is reason to believe that audiences will be large enough to make the expenditure of time and money worth while. Whenever possible, it is, of course, desirable, for a number of communities in the same vicinity to make arrangements for lectures at the same time, since in this way the traveling expenses for each stop made by the lecturer are materially reduced.

"The number of lecturers at the disposal of the department is limited, and it is not always possible therefore to comply with every request. When a lecturer cannot be sent, however, the department will loan a set of suitable lantern slides to any responsible local association or individual who will pay the express charges. The only requirement is that the slides be made of active and practical use in the community and that they be returned in good condition in ninety days. In addition a brief outline of a lecture to accompany the slides will be forwarded on request.

"In addition to this educational work the department is always ready to respond to requests for practical assistance which may take the form of special advice and inspection, superintendence of county roads, road surveys, experimental road work, bridge work or the development of a model system of highways for a county. To obtain such assistance local authorities should secure a blank form from the Office of Public Roads on which to make application. Requests from corporate villages or cities cannot be met, however.

"Bridge work is one branch of road building in which the department may be of particular service to local authorities. Typical designs have been prepared, and copies of these can be furnished on request. A few minor alterations would probably make such a design suitable for special conditions,

or an engineer may be assigned to inspect the site and offer suggestions. In some cases designs by bridge companies have been reviewed by the department for the benefit of local officials.

"Road materials are also being continually tested by the department and the information thus obtained is available for any community in doubt as to the kind of road they purpose to build. Similar tests can also be secured on dust layers, such as road oils and tars, and the department will furnish to any one instructions as to selection and shipment of samples. The tests are made free of charge when they are desired in connection with public improvements."

Education, agitation and promulgation will do wonders. In the last twenty and particularly the last twelve years, since the Good Roads Bureau was created, against the long period from 1806 to 1861, the road movement has gone ahead by leaps and bounds. Thirty-five states today have Highway Commissions. It is estimated that $250,000,000 per year is being spent for improved highways and our mileage of improved highways has grown from about three hundred miles in 1862 to over two hundred and fifty thousand miles at present, and practically all of these two hundred and fifty thousand miles was built in the last twenty-two years. Now is this progress? And if it is progress, have we not developed an A-No. 1 system for the building of roads?

The local man takes up ninety per cent. of the road traffic. He has the energy and money and becomes a better citizen by having the opportunity of doing this thing for himself and his neighbor, so why not continue to let him do it? From 1806 to 1862 our government appropriated $14,000,000 to build three hundred miles of highway. From 1862 to 1915 it has appropriated **brains,** and has built two hundred and fifty thousand miles of highway at a cost not to exceed two and a half million dollars to the federal government. Is not this a good plan and one that is delivering the goods?

Then again there is the question of discrimination. There are more miles of improved street paving in the United States today than there are improved highways. I am going to venture the assertion that it cost as much to pave the streets of our cities as it will cost to build the amount of improved highways necessary to carry the traffic of our country districts. The people who paid for the paving of the streets of our cities had no government aid and the burden in many instances fell upon those who had no interest in the traffic. There was no complaint. Our cities and towns are universally paved today, as it is recognized that their financial and civic life depends upon this improvement, and the step from the present highways, used in handling our country traffic

now, to improved highways, is just as logical and just as sure to happen as was the development from muddy streets to pavements, curbs and gutters in the city. I say that it would be just as proper for the government to pave the streets of the city as it would be to pave the roads of the country.

Speaking now of the federal government being interested in the way of directly building roads: Advice, education and assistance in the selection of types is the greatest aid that the government can render us, and if the government applies the energies of its good roads office to the determining of proper types and materials alone, I am satisfied that within the next five years, following their advice, we will be able to double the mileage of improved highways in the United States for the same money we now spend, that we will be able to cut the present cost per mile in half, and to avoid the building of types that lack the qualities of stability and endurance when subjected to traffic. Spirit, or will to do, will always accomplish more than money, on any given proposition. "Where there's a will, there's a way" and when the individual initiative of the great American citizen is aroused, leave it to him to complete the task. All he requires is guidance, advice and education. His energy is always present in superabundant quantity.

In proof of this assertion, I am going to refer to one of the beauty spots of this great state of California. Good to look upon, but bad to travel over. A county that I am told is sometimes disowned by both California and Oregon, on account of its backward spirit in the matter of improving highways, and I have heard it referred to as the seat of the anti-good roads sentiment in the United States. I refer to Del Norte county, the northernmost county of this state. In 1856, when the people on this coast were few and far between, a pioneer placer miner, Pierre Gasquet, settled in this county. In order to get his supplies from the Rogue River Valley to the Pacific Coast, he individually, through his own effort absolutely, built an improved road fifty miles long. Thirty miles of this road was hewn out of the mountain side, from solid rock and his road stands today as one of the wonders of the Pacific Coast. His crude hewn log bridges are as rugged today as the day they were built and this road still carries the traffic in the sections mentioned. This road would probably have cost at the present time between four and five hundred thousand dollars, but Mr. Gasquet, by using Chinese labor and a little black powder, and having the will to do, built this highway entirely through his own energies. One man built this road sixty years ago, established it and kept it in first class condition. Today there are three thousand people living in Del Norte County and yet

they are not capable, or interested enough to give the road even proper maintenance and it is very poorly kept at the present time, and until a few years ago was practically impassable. At present, sixty years later, the total improved highways of the county consist of this road of fifty miles and another one of forty miles, the latter running up and down the coast. The county is not in debt and is assessed for $5,000,000. Eighty per cent. of the taxable property in this county is owned by non-residents, who would willingly pay taxes for good roads.

Notwithstanding this, the people of this county yet lack the advice and education necessary for them to see the benefits of more good roads, four-fifths of the cost of which would be borne by non-residents of their county. Suppose that ten of the present three thousand inhabitants of this county had the spark of ambition that actuated the energies of old Pierre Gasquet, how many miles of improved highways would they have at the present time? So that I say it is purely a question of the desire of the individual. When you create the desire within an individual for good roads, good roads come, whether there lives in that community one hundred persons, or ten thousand persons. I am merely citing this incident of Del Norte County and Pierre Gasquet as an argument to prove that the most efficient way to get good roads is to build up a desire on the part of the individual for good roads, and I make the statement now that the most efficient assistance is that which will help us in the way of educating the individual, advice to the communities, assistance in the selection of types, and in the proper presentation to the people of this land, of the many benefits that come to them following the development of good roads in their community and the results will be tenfold as against the government spending its funds directly for the actual building. As soon as any community sees the light, development work starts immediately, and as in the instance cited above, if there is only one man involved and he has the right spirit, the right will and the right desire, he will make his roads alone, if there is none to help him.

This good road movement has been our doing, yours and mine. It is our propaganda. We are the parent of the child and responsible for its proper direction. Money is being spent like water all over the country to build improved highways. Half of it is being wasted and our responsibility, now that we have aroused our people to where they are willing to spend their money like drunken sailors for roads, is to see that they do not throw it into the bay, which the building of many types of roads now selected in various communities amounts to. This responsibility is ours. We are the only

people to whom the spenders of this money can look for direction. The government through the Office of Public Roads with its facilities for investigating all road materials, all road locations, and for keeping a history of traffic development on roads constructed, can direct us along safe channels in the matter of kind of roads to build and ultimately absolutely eliminate mistakes and save the taxpayers ten dollars for every dollar that it costs to maintain the office.

My state in its expenditure of seven million dollars a year has stumbled blindly along, sometimes getting good roads and sometimes poor ones, but always getting roads, because we have kept our propaganda going, but the solemn duty of every good roads member is to study building and road materials and to have the courage to disapprove any type of road that he believes will not stand up. This in my notion is our greatest responsibility in connection with the entire road movement at this time.

This good roads movement has taken hold of our people in such a way that the problem will never terminate until every highway in the United States now used is improved. There is not a city, or a hamlet, or a village in the United States that does not now have paving. Twenty years ago very few of the smaller villages had paving. The improvement of our cities followed as a natural development of the modern demands of business and living. Twenty years ago I moved to my present home in Colfax, Washington, a city of four thousand, situated in a climate where the rainfall is excessive in the winter. During four or five months our streets became almost impassable. Ten years ago, without opposition, our streets were paved with macadam. This lasted four years. Then without opposition followed the replacing of this rough, worn out, water bound macadam by smooth surface, up-to-date paving, with streets properly bounded by curb and gutters. There was no opposition and there is not a single citizen who would consent for any reason to go back to our old condition of living in the mud. They said the cost of these improvements, before they were made, would be absolutely prohibitive, yet they were made without being burdensome to anyone. This development has taken place in practically every town and hamlet in the United States and so will it happen in the country. Therefore, our greatest responsibility and our greatest care and need at the present time, as I said before, is so to direct the activities of those engaged in the active construction of these roads, that instead of having the expense of building twice, as many towns had to do in paving, and as we had to in our town, there will be but the one building necessary and that a building that will endure forever.

Just a word further on the road question as it affects me and my community. I live in a rural community. All the interests are purely agricultural. I have always been an enthusiast for good roads. I am a banker and have frequently fallen out with my orthodox brothers in that I am always willing to loan money to a customer to buy an automobile, if his credit is good, as it is sure to make a road booster out of him.

I am an enthusiast for two reasons. First, I enjoy good roads. Second, getting a man interested in the good roads movement makes a better citizen of him. When our town was living in the mud and grimy conditions before being paved, a man was careless of his appearance. As the improvements reached the residence districts, the lawns were brightened, flowers came into bloom, fences were fixed up, houses were painted and the good man was a little more careful about his clothes and his personal cleanliness and appearance. His mind was on the appearance of things and when you once center the mind of an individual on the appearance of things, you make a better man of him, because if he is clean on the outside, he will also be a little cleaner on the inside.

When a farming community gets good roads, as you go from the pavement of your city onto the broad winding boulevard to the country, you will note the improvement in the houses on the farms that are adjacent to the improved highway. Barns are painted, the fences are good, the machinery shining, the stock looks more contented. They are better stock. Some thought has been given to their selection and if you turn in the roadway to the man's door, he comes to meet you with a smile on his face and with a real welcome, because he has become more broad minded and he is really glad to see you. After he got an auto and had good roads to travel over, his community was enlarged. He met people in different walks of life and his associates were not limited to his farmer friends. He found, as men who travel about will, that all men are brothers, that the spirit of good will exists in all walks of life, that the rich and poor, the great and the small should have one idea of living and that is to make life more pleasant for the other fellow and thereby for himself. He becomes a better man to do business with. His ability to go to church is widened. His children attend school. His wife is able to appear more daintily gowned. She is able to take her place with her sisters who live in the city, as far as appearance is concerned, and her husband is more proud of her. So it makes the city and the country more homogeneous, a united country, one people and the love of mankind over all.

CHAIRMAN PRATT: Mr. MacKenzie's paper is now up for discussion.

Discussion by C. A. Kenyon.

Mr. Chairman and Gentlemen: While this is a very important and a very able paper, I must confess that the general principle of it runs counter to most of the papers that have previously been read upon this question. I find it also runs counter to my own ideas upon this subject. If you leave to the local community, to each little community, to the man who lives alongside of the road, the building of the road, all of this stuff about having a commission, about having a centralized power, about having expert direction, is all gone. I put that up to you strongly from personal experience. I live in Indiana. Indiana has the most localized government, especially in regard to roads, that there is in any state in America. I have had the opportunity to see its workings there, and if you will bear with me a few minutes, I am going to tell you a little bit of how it works there.

Indiana has an area of thirty-five thousand square miles. It is largely an agricultural state. We have some coal mines and some stone quarries, but gravel is almost everywhere. Whereas the great state of California here has over one hundred and fifty thousand square miles, I am informed by the Department of Agriculture that there is only about forty-three thousand square miles of that that you can call in farming condition. The rest of it is mountainous and has difficulties connected with it that we don't have. So that we have every advantage that would come about from the system that he speaks of. Well, what is the result? We have what they call in the East the township government. The state takes no concern about roads. They have no officer of any kind, no engineer, no one. All right. We leave it to you. What has been the result? The county builds no roads. Not a road in Indiana has been built by the county, and yet when you look under the classification of the improved roads that is published by the Department of Agriculture and by the state statistician of our own state, we have more miles of improved road than any other state in the Union—over thirty thousand miles of improved road. Well, you would say that bears out the doctrine. Well, how is this done? Of course we commenced to build roads back in the thirties. Then the railroads came along and we thought we didn't need any roads, and so we let the roads that had been built and were being built before that go into decay, because we thought everybody was going to be satisfied with the railroad.

In a little time that era passed, and along after the war they commenced working on the highways again. What did they do? They passed what the farmers demanded. They said just what he has been saying now, that these roads belong to us, they run alongside of our farms, they are for the benefit of us more than anybody else. We use them more than anybody else. Therefore, we want the control of them. We want the right to build them. We know all about how to build roads and we don't want any interference by any state officer or anybody else. They are ours and we are going to attend to them. So they got what they called the three-mile gravel road law, which has been amended from time to time. What does it provide? Whenever they wanted to build a road in any township they got a petition signed by not less than fifty freeholders of that township. Now there are ten hundred and seventeen townships in that little state of thirty-five thousand square miles, and we have got ten hundred and seventeen units for building roads in that way. We have ninety-two counties. Now, when they did start in—"Well, we want to get a road along here in our township," they will say. They started out and they got all the farmers that there were along that road. There are six, and there they stuck. They were going to have one fine road because traffic was pretty heavy there and it was a main road through that township. What do they do then? They go over to the fellow living next North and they want him to sign the petition. He would say, "Get out, I am not going to sign your petition to build a road and have you charge a part of the cost on me. No, sir, I will not do it." "Well, put your road in then." Then they tell him if he signs the petition they will build the road up to his place. Then he would say, "Oh, well, if you are going to build the road up to my house, let us have the improvement." So they put in his road, and so they go all along the road. They haven't got fifty signers yet, and they go on to the next and the next, and while there would be, as you say, a township six miles square, there would be six times six, or thirty-six roads. I know this last year in Marshall county they had thirty miles of road in one petition before they could get fifty signers. They had started out with the idea of having a good permanent road such as he described that will last forever, as some of them said.

When they got through they found out that the state law prevented them from bonding the township to exceed four per cent. They found out when they came down to it they couldn't build this high-class road and so they reduced it from four thousand down to three thousand and down to

two thousand, and finally they could only spend fifteen hundred dollars per mile on the road. They asked me to come up and make a speech to help them in their vote on it. I said, "Here is what they call the Michigan Road, running right through the center of the township where the traffic is ten times what it is on these other roads." "Now, don't make such a speech as that, Mr. Kenyon. For God's sake, don't do that. If you do it will defeat the whole proposition," one said. He said, "I am entitled to have a good road. I am entitled to have just as good a road as any man and I am going to take my name off that petition just the minute you talk about putting a better road in over there than I get over here." This was the extreme limit of the township. The result of it was they carried the vote and they issued bonds running serially from one to twenty years. What kind of a road did they get? Fifteen hundred dollars per mile of road where there was one hundred to one hundred and fifty vehicles going through on this main road. It hadn't been built three months before the road almost went to pieces because they used cheap gravel and the traffic on the road was heavy. The next man to sign lived at the end of a three-mile road. He didn't sign because he didn't have a road. They said, "Well, you are the only one in there to build this three mile road for." He said, "I am just as good a citizen as any other one of you men and I am entitled to a road just as much as you are entitled to a road. I want that. Yes, sir." So they agreed to build the three miles of road if he would sign the petition. They paid forty-five hundred dollars for the road, so that man could go to town maybe once a week or twice a month. The bonds run for twenty years. They could have just built an earth road which was already there; but no, one man man was just as good as another and he was going to have just as good a road going up to his house at the end of the three miles where there was not another place along the line as that main road, where there was traffic of from one hundred to one hundred and fifty vehicles a day. That is your localized system.

Now, when we came up to the administration of that let me take you a step farther. They said, "What do we want? We are going to have this gravel road. Now, we don't want any contractor to come in here from any other township. We want it fixed so that nobody but contractors in our township can get this, and we want to use the gravel in the township." Engineers said, "Well, but this gravel isn't very good, it is too fine. You better go to the next township to get gravel." "No, sir. We will have our local material, the material that comes off our land. It is going

to be charged against us and we are entitled to sell the gravel for the road even it is a little fine." Then they were not going to have any engineers except a local man, and someone suggested that the contractor—there was not any contractor in the township that had a roller—they were looking over the specifications that had been sent out by one of the other counties which required a ten-ton roller, and one said, "Don't you know very well that there isn't a ten-ton roller in the township? We demand that that clause be taken out of the specifications. What does General Jones' roller weigh? Well, it is a five-ton horse roller. Put it in there." So they demanded a five-ton horse roller and said that the five-ton horse roller was just as good as any roller in the state, or any other state. "They come here and talk about these experts. We know just as much about roads as anybody and we don't want any smart alecks to come here and give us any advice about that." (Applause.)

That is the way they looked at the roads. They have got that four per cent. indebtedness on every piece of property in that township. Now, they have got their state and county tax in addition to that, and here is a great highway that half the people in the state are using and if they get this Dixie highway going, it will be the road that is used right up there by all the people from the southern states going up to Chicago and thousands of them coming down from Chicago. It is our road and it is being worn out by the people in Illinois, the people in Kentucky, the people in Tennessee, and the people in Ohio. They built it for fifteen hundred dollars a mile, and how long will that road last? That is the problem.

Isn't it a different proposition than the mere matter of the local? It is the one who uses it after all. If the people of the country use a certain line of roads why shouldn't all the users help pay for that line of roads? And if they do, why shouldn't the nation help build a portion of the highway? We are building roads up in Alaska. We are building roads out in the Philippines. We built a transportation system down in the Panama Canal. We are building roads in our other possessions. Why not use some of that money that we are all taxed for in the building of roads in our own country for our own people who pay the taxes and use the roads. So that I am in favor of having the roads classified, and those roads that are classified as national highways should be built under supervision of the government (applause), and those roads that are largely used by the state let the state build as a state system, and those that are used by the county let them be built by the county, and those that

are used only by the township as neighborhood roads, let those people build those roads, each one according to the traffic that goes over the road. Classify them in regard to the cost as well as to the distribution of expense. I submit that to you and ask you if that is not a better system.

We tried in Indiana to get the counties to have a state engineer and to use him for advice for the preparation of specifications, for giving them directions to help build their highways. No, sir. Just the minute you employ a state man he will apply Indianapolis ideas and we don't want him. He will be telling us that we ought to use stone on this road when we have got plenty of gravel. That is the way they talk, and when it comes to repairing the road it is the same way. We had an investigation last year in Indiana. The governor appointed a commission to go around the state and hold meetings in each congressional district. I was on the commission and the commission held hearings in each local community, and you would smile to hear some of the statements made by the farmers. They came in all interested in it, but I want to tell you their ideas were fixed on the subject and the legislation afterwards recommended was defeated, as apparently the farmers didn't want any interference. One farmer got up and said, "I want to give you a little idea. When these roads are built by the township by a bond issue they are turned over to the county and the county is supposed to keep them in repair, and what do you think that this county highway superintendent wants us farmers to do? Why, he wants us to come out and work on the roads in the spring when we have got to plant our crops. We are not going to do any such thing as that. We have got plenty of time in the fall, and furthermore, I want to say I came home and found my son getting one dollar and seventy-five cents a load for hauling gravel, hauling two loads a day. I said, 'What? Charging the people of my county three dollars and fifty cents for two loads of gravel? It is an outrage on the taxpayers of the county. I won't stand for it.'"

When he got through there was a man who came in afterwards that got up and said: "Look here. I don't like that; that is not fair. Gentlemen, I am the assistant superintendent that hired that man's team. Do you know what he wanted? He wanted me to hire three of his teams, and he wanted to haul from a gravel pit that was close to his farm where there wasn't gravel at all; it was just sand. I wouldn't do it, and the only place that there was gravel was seven miles away and somewhat up hill, and lo and behold after I had hired one team instead of three, as he wanted me to, and he found that it was a seven mile straight

haul for a load of gravel, and I insisted on having the full load, it was pretty hard on the team and it began to pull them down, and then he got righteous and called it off, and now he comes down here and makes this kind of a speech that he is making to you. He says he wants that office abolished, but am I going to keep up the roads if I use sand instead of gravel because it is a close haul and because the farmer wants me to use his team at three and a half per day? Every farmer around there wants me to wait until fall when he isn't doing anything else. Can I get them to spread gravel? Not on your life I can't. They are willing to haul it and dump it, but when I want them to get out and spread it, no, sir, they won't do it."

Now, that is the man who got up his righteous indignation and made that sort of a speech before the commission; and there were plenty of others. Now, that is the localized system. What have we got in that state? We have got over thirty-five millions of those bonds outstanding, none of those against the cities, practically all against the townships, letting the city of Indianapolis that pays one-twelfth of all the taxes in the state, letting that city off with only forty thousand dollars of bonds against it, and a little county like Park county with three thousand inhabitants bonded for eight hundred and seventy thousand dollars, just by this process that he was telling about. That is that local thing. We have got it in Indiana as they have it in no other state in the Union, and I am giving you an idea of what that local method of building roads produces.

Now what kind of roads have we got? We have got thirty thousand miles of road, but you go out over the roads, and lo and behold you find two deep ruts. They all drive in the same line and then the water gets in and sinks into the foundation of the highway at the center where they have dumped the gravel in it and let the travel wear it down. As I was telling you a moment ago, they don't want the expert, they want to do it themselves, and as a farmer explained it to the commission, "These experts will tell you that it is necessary to spread the gravel. It is a darn sight better to let the travel spread the gravel. You put it in the center and as they drive over the road it pushes the gravel down and then the wheel compacts it at the edge, gets it solid there and keeps wearing it down and that outer wheel packs it tighter and keeps on until you get it packed fine." (Applause.) I am just quoting to you what men say under this local system. We have got about the same population in the state of Indiana that you have in California. We commenced many, many years before and when I came out here to California and rode with Mr. Fletcher

over five hundred or six hundred miles of your highways down in the southern part of the state, I said, "I wish the farmers of Indiana could come out and see these beautiful highways that were built under the direction of skilled supervision."

I met a farmer on the street one day. He came up and hit me on the shoulder and he says, "Kenyon, I want to apologize. I have cussed you and I cussed the highway commission because you advocated better roads than we had in Indiana. I thought we had good enough roads, considering the fact, too, that we finally got the bill through requiring all heavy automobiles and heavy loads to be prohibited from going over the roads in wet weather (applause); but since I have been out here visiting my daughter and have been over some of these roads I feel like bowing my head and apologizing. I promise you when I go back I will go and say, like Billy Sunday says, I have repented. There ain't anything that starts a person on the way to reform like a little repentance, and just being frank about it."

I just felt that it was necessary to say this much on the other side, where I have had the experience. I have been studying and have been interested in this cause for twenty years. I am not an official of any kind except that I am president of the Indiana Good Roads Association, but I have never held any office and I draw no salary of any kind, so that my study and information in that way is entirely disinterested. (Applause.)

EZRA MEEKER: Mr. Chairman, I am from Indiana. (Laughter.) Sixty-four years ago I left Indiana, just a little way out of Indianapolis. I want to tell you a little incident. It won't take me very long. We had a character in our neighborhood we called Old Robey—Robey was his name. Well, in that locality they wanted to get a road through his place or along a certain line. "No, sir. You can't come there." Well, I married and left Indiana and came out to the Pacific coast up in Washington. Washington was made after I got there. I have lived there since, but eighteen years afterwards I went back and visited the old place and my old comrades. One of my comrades said one morning, "I have got to go to Indianapolis. We are working on getting a road through Robey's place." (Applause and laughter.) Gentlemen, this is an absolute fact. I can shake hands with my friend when he depicts Indiana scenes. I don't know whether to be ashamed of coming from Indiana, or proud of it. (Laughter.) I know I was glad to get out of it because I couldn't get land there and I could get land when I came to Oregon.

Now, I thoroughly believe that we should have government aid for roads, or rather have government roads. (Applause.) It is a hobby of mine, they say, but I am for federal aid for the trunk line road. I have a scheme on hand and I am going to spend the winter in Washington on that very work of striving to get aid for a government road, a thoroughfare, a road that shall reach from the Missouri River to the tidewaters of the Pacific as a trunk line road in which the states and nation shall be called upon to cooperate. We are going to strive to get the government to make the survey and estimate of the cost to the five states, and ask them to assume the building and maintaining of that road when the states will give the right-of-way and deposit half of the cost, and ask the government to build that, not only as a thoroughfare for the convenience of the public and the automobilists, but for military purposes and post roads. Talk about your preparedness for the defense of our nation, we need such roads for keeping the nation prepared; for the defense of the nation. I have prepared a paper on this subject that I hope I may read before we get through with the congress. This matter has stirred me up and I feel so much in accord with what the speaker has said that I couldn't hold in. (Applause).

MR. MACKENZIE: I would like to ask the gentleman from Indiana just one question. Have they a highway commission in that state?

MR. KENYON: No, sir; not a highway commission nor a highway engineeer, and the state pays absolutely no attention to the roads.

MR. MACKENZIE: I would like to have about five words in reply to some of the things that have been said, if the Chair will permit me. I just want to say that I sympathize with the gentleman from Indiana. The farmers used to have us buffaloed in Washington like they have got you buffaloed in Indiana. As long as you stay buffaloed and until you show them that the money spent on these roads will come back to them, why you will not have good roads, unless some of us fellows out here on the Pacific coast contribute money to help build roads in your state. We got away from that situation out here. I lived in that condition twenty years in my state. I know all about the local feeling. I was raised on the farm and I know just how my father used to think about those things. By the passing of the law in our state they provide for a highway commission, they provide for our Permanent Highway Act, they provide for the building or improvement of highways starting at trade centers and going out into the country,

the cost to be borne to the extent of fifteen per cent. by the property owners, the balance being borne by this mill and a half tax. The permanent highway is built under those conditions and we get clear of all those troubles.

I attended a meeting in our town not two months ago where there was six hundred active, genuine farmers present and I never heard a more intelligent discussion of roads and road conditions. I heard the farmers advocate the very highest type of roads that are being built and they are willing to pay for them themselves. My position is this: the federal government of necessity will have to build some roads. The national parks are owned by the government. They have got to build those roads, but thirty-five states have highway commissions and are now making as rapid progress in building highways as is consistent with the development of types of roads, and it would be unfair for these states who have been unable to start the devolpment of roads in their states to ask us to contribute now to the federal government for the assistance of these recalcitrant states who have no system, no highway commission, and who have not tried to get the people back of these roads that they need for themselves. I think that a lot of people have got the wrong idea of the farmers. I live right among them, and I am not afraid of them at all; and I find them just as intelligent, just as able and just as efficient as any other class of business men; but just as long as it is in politics they think they have to be taken care of.

MR. CARLTON: Mr. Chairman, if a highway commission is a good thing for the state, if a highway commissioner's work is good for the state, why isn't a national highway commission and a national highway engineer good for the states? I would like to say that there is one point that has been overlooked by all these gentlemen discussing this matter of the aid of the national government for roads, and that is the construction of roads through such countries and such states as Nevada, which has such an immense area and such an immense mileage of roads, and so few people. It is a state with over one hundred thousand square miles and with only eighty odd thousand people, and a very limited amount of taxable property. Now, to me the federal government should by all means construct roads through all places where the population and the valuation is so sparse that it is absolutely, not theoretically impossible, but absolutely impossible, to build roads. For instance, take the desert sections of Arizona. Take the desert sections of Nevada and California, and the swamp lands in Louisiana, and such places as that, and I say, gentlemen, it is no more than right, no more than just, that the federal government should aid in the maintenance and construction of roads through such places.

The federal government—the gentleman says something about this matter being another pork barrel—this other gentleman that insisted that it is not within the province of the United States government to do that as well as it is to go down and build the Canal, or do the hundred other things that the federal government is now doing. There may be a little pork barrel to it, but I tell you, gentlemen of this meeting, if these roads are built where the politicians can get the votes they are going to be built where the roads are needed. (Applause.)

MR. COBB: I think that Mr. Kenyon so completely answers the argument of the gentleman who read the paper that there is nothing to be added to his remarks except with reference to one point. Mr. MacKenzie cast considerable reflection on the politician. Now, I couldn't sit idly and quietly by without saying something in defense of the politician. I thought Kenyon was one from the way he talked. I want to say that I am a politician. We are all politicians over in Arizona, and I think that an honest politician is the noblest work of God. (Laughter.) We must not forget, too, that in a republican form of government you are going to have politicians. Your politician represents the intellectual and moral status of your community. I was very sorry, believing that, to hear such bad accounts from Washington, but you all know that that is a fact. Your politician represents your community.

Now, I want to say just one more word on one feature that Col. Stevens mentions in his paper. He mentions several states that he thinks have reached the furthest point of advancement in road administration. He mentions several of them. There are about ten, I believe. In the evolution of road management, beginning about 1890, I think the management of road construction was entirely in the hands of the smallest political subdivision, and I think it was probably the instrumentality of the Society of American Wheelmen that first brought about a greater centralization of authority, and then has come the automobile. Now the first advanced step that was taken was by the states of New Jersey, Massachusetts, New York and, as I say, about ten others, and I am glad to say that Arizona is one of those ten. The state advanced fifty per cent. of the cost of the construction of roads and it was done under state supervision. Now these ten states which I have in mind have gone a little further than that. The state makes an appropriation and the money is expended under the direction of the state. Now you will see by that that the first states that took up the assistance in the construction of roads have advanced further and are now constructing the roads them-

selves without the assistance of the county. Now we will have to admit that the most advanced states now in road construction and those that have the best roads have made a mistake in this policy if we adopt the ideas of Mr. MacKenzie.

I would just like one particular word and that is with reference to the centralization of authority mentioned by Mr. Stevens. When talking a little while ago on the subject of maintenance, I think my remarks should have been qualified. I don't mean to say that you shouldn't endeavor to put something in the law to provide for maintenance, but I couldn't see how you could put it in the law, bonding law, to provide for maintenance. Now, the only way in which maintenance can be gotten is through educating the people to the necessity of maintenance, and the necessity of furnishing them with accurate data relative to that particular feature of the work. It is through the centralization of authority that you are going to get your maintenance and never where your authority is subdivided down to the counties. (Applause.)

JUDGE J. H. ALBERT: Mr. Chairman, the term local authority is not definite and the application made by the gentleman from Indiana is not possible with any other state. Local may mean county or whatever the unit may be. In our state, the state of Oregon, the county is the unit. We have a state system there for building through trunk roads. We have a county system by which the counties themselves give under proper proceedings; also the townships may, under the direction of the county or rather by turning the road over to the county, levy tax for improvements in their townships, but we have counties in our state, I think about ten thousand square miles in one of them, and we have a district there that has, I think, six or seven thousand square miles in it. So you can't apply that argument to our state or to any western state that I know of, and if it is applied to Indiana in the manner in which it was applied it would indicate to me that he better not go back to Indiana if he has told the truth, and he has, evidently. We couldn't do that with my state, but I think it is a question of the word local, whether the unit is the Township or the county, or the district. In our state no authority except the county may establish the road. The state may improve its roads, but the county may improve its own roads. I know that the condition described in Indiana doesn't apply to Oregon. It might to Washington, but I am not surprised at what the gentleman has said. I went through southern Indiana at one time about ten years ago and my experience and observation at that time would attest the truth of he gentleman's remarks.

CHAIRMAN PRATT: There are two notices I want to read. Before we adjourn I want to announce the smoker at seven-thirty tonight to which the delegates and friends are invited. I have just received a telegram from Providence, Rhode Island:

"E. L. Powers, Secretary American Road Builders' Association, care Pan-American Road Congress, Oakland, California.
Providence, the southern gateway of New England, with many and varied attractions for your association, would be honored to entertain the American Road Builders' Association Convention in 1916. We will provide necessary hall and a splendid programme of entertainment if you come to Providence.
(Signed) Fred Mansfield,
Chairman Committee on Conventions, The Providence Chamber of Commerce."

I am sure all the members will be indebted to the Tri-State Good Roads Association for adjourning its session and becoming a part of this congress. It adds a great deal of interest to have the two organizations come together and take part in our program. If there is nothing further to come before the meeting now we will stand adjourned until ten o'clock tomorrow morning.

An adjournment was then taken until Tuesday morning, September 14, 1915, at ten o'clock.

MONDAY EVENING SMOKER.

The delegates and members attending the congress were entertained on Monday evening, September 13, by the Commercial Club of Oakland, which gave a smoker at the Hotel Oakland.

SECOND SESSION

Tuesday, September 14, 10:00 A. M.

JAMES H. MACDONALD: I don't think it is necessary to make any apology for the counter-attraction that seems to deplete our ranks at our sessions, nor would I want any one to ascribe it to any lack of interest in this great cause which we have come here to discuss. It is simply the greater counter attraction just for the moment; but they will all be here before we get through. I take great pleasure in introducing to the congress Mr. George W. Tillson, the president of the American Road Builders' Association, who will now take the chair.

(George W. Tillson then took the chair.)

CHAIRMAN TILLSON: Mr. MacDonald and Gentlemen: It affords me a great deal of pleasure to act in this capacity today. The first paper on the program for this morning is on "Proper Road Location: Its Importance and Effects," by William R. Roy, State Highway Commissioner of Washington. I take great pleasure in introducing to you Commissioner Roy. (Applause.)

MR. ROY: Mr. Chairman and Ladies and Gentlemen of the Road Congress: I have prepared a short paper on a question that is a leading one in this country, not only on the west side of the country, but all over. This is a question that has been growing for a number of years and is destined to assume a great deal larger proportions in the near future.

Proper Road Location: Its Importance and Effects

By WILLIAM R. ROY

State Highway Commissioner of Washington

The object of this paper is to present, briefly, some of the phases of this subject which confront the highway engineer at this time.

The purpose of a highway is to carry traffic. The traffic will naturally vary with the district which is producing or attracting traffic; so the first consideration of the locator, in the broadest sense, will be the district to be served. It may be said that the districts requiring highways fall naturally into three classes, which may be designated as urban or residential districts, scenic districts, and agricultural districts. On account of the fact that these classes necessarily overlap in many cases, the distinctions indicated have their greatest effect upon the location of highways, rather than upon the details of construction, where a broad-gauge

general policy is to be followed by the executive charged with highway administration.

In referring to urban or residential districts, I have in mind the suburban areas which are adjacent to most of the large cities of this country, with at least a fairly "well-to-do" population, able to own comfortable homes and to pay for the extra transportation required by the greater distance to the business centers. Such a district both produces and attracts traffic. The original development of such districts was made possible by the electric railway; the highways were of secondary importance. Now the small motor vehicle has become the important factor in transportation, and the development of highways has become of first importance. The traffic produced by such a district will be almost exclusively comparatively light passenger vehicles, with ample power to climb almost any gradient even up to 20 per cent. The hauling which the district requires will be confined to materials for the construction of new residences or other buildings, and such heavy supplies as fuel. The locator therefore will have as his first consideration what may be called the accessibility of the highway, and safety of the traffic. He will not be confined to a narrow range of gradients, but will endeavor to find a proper middle ground between the extremes of grade and cost of construction. In locating a highway for the residential development of a previously unoccupied district, the engineer has his greatest opportunity. The proper location will involve plans for connecting drives to the main artery; consideration of the future requirements of the community for sewerage and storm drains; the disposal of surface water; intersections of existing or contemplated railways; and the possibility of snow blockades in winter. As in most cases the cost of such a highway must be considered an eventual charge upon the property of the district, the choice of proper location is too freqeuntly restricted by that cost; but the attitude of the public toward this factor is improving with the increasing demand for safety of traffic.

The location of highways into scenic districts brings with it a set of problems which are pre-eminently of an engineering nature. The purpose of such highways is to afford access to districts of natural beauty. The choice of routes may be influenced by the existence of attractive camping grounds, in addition to the principal points of interest which are to be reached. The only restrictions placed upon the engineer are those of expense and safety of travel. Another consideration, which is rapidly becoming of first importance with the extension of this type of highways, is the cost of maintenance. This is particularly true in the mountains of the Pacific Coast, where conditions of soil, drainage, and

snowfall have a vital bearing on upkeep costs. Gradients as high as 8 or 10 per cent. may be utilized in order to keep the cost of construction within reasonable limits, but these gradients should be reduced on sharp curves in the interest of safety. The importance and effects of proper location will be seen in the resulting popularity of such highways, and in the much talked of development of our natural resources.

Problems of a somewhat different type are encountered in planning highways for a large farming district of a flat or only gently rolling topography, where the farms are held in large units and the population is scattered. The prevailing systems of roads usually follow the subdivisional lines. The traffic will be heavy at certain seasons of the year only. On account of local prejudices, it is often very difficult to select any highway, or system of highways, for extensive improvement. With existing highways on the rectangular system, it is seen that a farmer living eight miles in an air line from town, may have to travel from nine to twelve miles along the section lines to reach his market. The ideal system for such a district would be a combination of the rectangular method with diagonal arteries radiating from the markets.

Existing roads in the thickly settled agricultural and industrial districts in the United States are also frequently laid out on the rectangular system, and in addition have been fenced up to narrow limits. Such a system can not often be used to best serve the modern requirements of the entire community, especially in a district devoted to truck gardens and dairy interests, where the bulk of the heavy hauling is fairly constant throughout the year. The location of a great trunk highway through such a district, and connecting industrial centers, should be along the principles long established for the location of railways, with the modifications due to the permissible maximum gradients. The short-haul transportation of heavy commodities to the nearest suitable market or point of rail shipment is the important consideration. It is a generally accepted rule that the maximum gradient of such a highway should not exceed 5 per cent.; and curves should be planned to afford a sight distance—that is, the greatest distance at which the drivers of two approaching vehicles may see each other's machines along the road—of not less than 250 ft.

In a country of rolling topography, with frequent stream crossings and railway intersections, the route which the engineer recognizes as the best location will almost invariably cut through highly developed property. The right of way for such an improvement will usually have to be obtained at high figures, both in the value of land taken, and in

damages to the property thus divided. While this cost often seems prohibitively high, it must be recognized as being what we may call a "capital charge." Here again one is struck by the resemblance between the fundamental principles controlling the location of a railway and those which should control the location of a great industrial highway. While it may be somewhat foolhardy to attempt to predict future developments in short-haul transportation, the conditions which have arisen during the past six years may indicate, in some measure, what may be expected; and may be taken by the locator as his guiding considerations in selecting a route for a new highway or in improving the route of an existing highway. In the same way, is it not true that the development of the great railway systems may afford much counsel to any community in planning the size of the financial investment that should be made in a new highway? I refer particularly to the financial investment in rights of way, grading costs, and stream crossings, rather than to the surface structure of the highway.

This brings us to the consideration of operating costs, and the influence that these costs should have in the locator's selection of a route. There are very few published data on the actual costs of motor vehicle operation, or the effects of grade and curvature upon these costs. This subject should be a fruitful field for investigation by our highway departments and technical schools. However, it is a self evident fact that more power is required to move a motor truck up a 5 per cent. grade than over a level grade, or even one of 2 or 3 per cent. Also, it is probable that every person who has driven a motor car has noticed that a curve in the road on a 5 per cent. grade will very appreciably increase the amount of power required to climb that gradient as compared to the power required to climb a similar gradient on a tangent. As the number of vehicle units increase, it must be evident that operating costs become of more and more importance in the matters which the highway locator has to consider.

To any person who thinks that the effects of grade and curvature on operating costs may be disregarded by the locating engineer in planning a highway of the type referred to, as being too finely drawn for present consideration, I wish to cite certain conditions which have developed in many sections of the Pacific Coast in recent years. No doubt similar conditions exist in all parts of the country, but I refer specifically to the Pacific Coast on account of personal observation of these conditions. We have many fertile valleys, capable of intense cultivation, which are closely settled, at least in the vicinity of the larger cities. These districts produce large quantities of vegetables, fruits, and

dairy products—all commodities requiring prompt transportation throughout the year. In past years these commodities have been hauled by the electric railways. Following the construction of improved highways, or at least improved surfaces, there has grown a formidable system of motor vehicle transportation, carrying both freight and passenger traffic. In handling freight, these motor vehicles collect produce practically at the farmer's gate, and deliver it to the door of the commission house or butter factory in the city, at the same freight tariff formerly paid to the railways, and with the elimination of the drayage charges at either end of the haul. A similar condition exists in the short-haul transportation of passengers. There have been placed in profitable operation many lines of large capacity passenger automobiles, which pass close to the farmer's door, and which will carry him to town quickly and conveniently, and at a reduced rate over the former passenger tariffs on the electric or steam railway lines. Probably no better example could be found of the truth that increased convenience in transportation will result in increased volume of transportation. This increased traffic in turn has produced more problems for the highway officials and locators. The highway that was built a few years ago, with the grades and curvature that seemed to the locator to be justified by existing traffic conditions and topographic obstacles, is now intolerably crooked, and the grades are too steep.

These conditions have been evident for some time to those officials charged with highway maintenance; at least we have heard the most about them from such officials through the medium of the technical press and from the platforms of association meetings and conventions. Is it not probable that at some not far distant time we shall begin to hear from the owners of motor vehicles about the cost of operation?

On going into this subject, the engineer finds that the proper location of the heavy-traffic, year-around highway involves consideration of factors which have long been prime essentials in the best railway location; but which have not been supposed to be worth taking into account in planning a highway. Among these factors may be cited, in addition to the matters of grade and curvature already mentioned, the necessity for stopping and starting heavy motor trucks to pick up and discharge freight and passengers; intersections with cross-roads where the average speed may not be maintained; and the necessity for widening of the traveled way as the volume of traffic increases.

CHAIRMAN TILLSON: This question was to be discussed by Paul D. Sargent, state highway commissioner of

the state of Maine, but unfortunately Mr. Sargent was not able to be present. In the East the question of highway location is comparatively a simple one, and to me as I suppose to most eastern engineers, the sights that we saw in coming down on this western coast are very remarkable. I had the opportunity of seeing two of probably the greatest examples of road that there are in this country, if not in the world. One of which of course you have all heard, the Columbian Highway on the South bank for a great distance of the Columbia river, and the other the road over the Siskiyou Pass; both, as I said, remarkable examples of location. The engineer who is responsible for one, and I think both, of these roads is present, and I know of no one who is more qualified to discuss this question than he. I am therefore very pleased to introduce to you Major Bowlby.

MAJOR H. L. BOWLBY (Washington): Major Crosby spoke to me last evening and said he wanted me to start the discussion on Mr. Roy's paper. He said also that he didn't have a copy of Mr. Roy's paper with him, so not having the paper to look over I jotted down a few points on "Road Location" and will not be able to take up Mr. Roy's paper in anything in the discussion except for a few points that I jotted down. To all engineers who have had to do with the building of roads the importance of the location of the road is very apparent. It has many times been said that drainage was the important factor in road building. I believe that that is true, but it is also true that you cannot get proper road dainage if the road has not been located properly, so that to my mind the most important factor in road building is the road location. Here in the West we have a problem altogether different from those of the engineers who come from the East, and especially the far East. There your roads have been located for many years, most of them for a hundred years or more, and in your work of today you have to improve those roads and relocate them as best you can, staying usually very close to the line of the road as it now exists. Here in the West we have a different problem. We have practically the whole country before us in locating the roads, and I feel that we have a greater responsibility out here than the engineers of the East have, because today the roads are being located, and if they are not right in the future it will be the fault of the engineers who have charge of the roads today. Land values are very cheap here in the West, compared with land values in the East.

In all of my highway work here on the Pacific coast I have tried to follow a few general principles of highway building. First, not to make any grades over five per cent. on the main trunk roads of the state in which I work, and not

to have the curvature exceed that of a radius of two hundred feet except in very difficult cases where the topography requires a shorter radius or a very great expenditure of money. In that case we have reduced the curvature to one hundred and fifty feet, and in some places to one hundred feet, but in no case under one hundred feet, and wherever the road has been running on the ruling grade, or the maximum grade, and it has been necessary to make a radius of curvature less than two hundred feet we have followed the principle of reducing the grade on the curve at the rate of one per cent. for every fifty feet that the radius has been reduced, so that where we were locating a five per cent. grade and had to put in a curve with one hundred feet radius we would have on that curve a three per cent. grade.

During the last two years I had the honor of being state highway engineer of Oregon. We had the location of two very important roads, the Columbia Highway, which is a road starting at the Pacific Ocean at Seaside and going up the Columbia river on the south bank for a distance of about two hundred and twenty-five miles. This will be, with the Pacific Highway, the two important roads of Oregon, the Columbia being an east and west road tying together western and eastern Oregon, and the Pacific highway a part of an international highway running from Canada to Mexico. In locating the Columbia highway we tried to follow the best principles of road location and today the road is open, although it is not entirely constructed, from the sea to Hood river, and in traveling the whole road you can drive through on "high."

In starting out the work in any state you are up against the criticism of the laymen, those who are not acquainted with engineering, the needs of engineering; with the criticism for spending money for preliminary engineering; that is, spending sums of money for locating roads and in getting out the plans and specifications. I think this is always the most bitter in the beginning of road work in any state. The location of the Columbia highway cost from two hundred dollars to about four hundred and twenty-five dollars a mile, the most expensive portion of the location being in Multnomah county. Those of you who have seen it realize the difficulty of the country through which this road was located. I jotted down last night a few of the instructions that I have given to the locating engineers in the field which I thought would be of interest to this congress and of special interest if printed in the proceedings of the congress. These instructions outline briefly the manner in which the survey is carried on, the data that are obtained and the manner in which all of this work is done.

Road Location.

By HENRY L. BOWLBY

Executive Officer, Pacific Highway Association

Instructions to Locating Engineers

Engineers in charge of location will run an angle line, keeping it as nearly at grade as may be, and take topography with sufficient care to enable a map with contours at intervals of five feet to be accurately plotted.

Topography will be taken by taking cross sections—with a hand level. Where the nature of the country is such that this is impracticable, it may be taken with a slope board or clinometer.

Note the size of all streams and high water marks whenever obtainable. Note also character of materials, whether earth, gravel, rock, etc., also all clearings—in fact, everything which will be of use in estimating the cost of the work.

The transit notes will be kept as shown on the sample page of transit notes furnished by the department. The magnetic course must be in all cases be read and recorded.

Bearings of all courses, or lines, should be given with reference to the true meridian, and for that purpose an observation of Polaris, or of the sun, should be taken upon starting the survey, and the true course be taken in the field books. An additional observation should be taken for the correction of meridianal convergency, whenever the extent of the survey shall attain a departure of one-half degree of longitude.

Curves and bearings of tangents shall be noted on the maps and profiles in the manner shown on the samples furnished by the department. When practicable, give true bearings instead of magnetic.

When the degree of curve "D" is less than 10 degrees, the length "L" of the curve may be computed by the formula:

$$L = 100 \text{ times } \frac{\Delta}{D}$$

When "E" is 10 degrees or over, figure the length "L" as the arc of a circle. thus:

$$L = 2 \text{ pi} \times R \times \frac{\Delta}{360}$$

Grades

Grades shall be established in even tenths, and a maximum grade of five per cent. will in no case be exceeded. All angle points should be marked according to station numbers. The notes and profiles must show all culverts, drains, bridges, etc., with sizes; indicating whether existing or proposed.

The minimum radius of curvature allowed will be two

hundred (200) feet. When it is impracticable to use a radius as great as two hundred (200) feet, on account of peculiar topographical features, with the consent of the state highway engineer, a lesser radius may be used, but in no case will this be less than 100 feet.

When a radius of less than 200 feet is used on a maximum grade, a grade compensation of one per cent. for each fifty feet of reduction of radius will be used. Thus, if it is necessary to use a 100-foot radius curve on a five per cent. grade, the grade line on the curve would be reduced to a three per cent. grade.

Field Books

All field books shall be properly indexed in ink, and where more than one field book is used in a survey, a complete index of all field books shall be made. The book containing this index shall be marked on the book "Index."

The name or number of the road, or both, and the year, shall be given. All field books shall be marked with the name of the road, the year, and county, on a fly leaf; also the name of the engineer in charge of the party, the transitman, leveler, topographer, and such other data as will make the notes clear and intelligible.

All note books shall be kept according to the standard sheets sent out by the state highway department.

The rodman working with the leveler must keep a book in which is to be recorded the turning points. The elevations of turning points and heights of instruments are in all cases to be compared with those of the leveler, and found to be correct, before proceeding with the work.

Levels should be run in one direction and checked in the opposite. The two will be compared by means of the following formula:

$$E = C\sqrt{M}$$

Where "E" is the error between the two runnings, and "M" the distance in miles, "C" must not exceed 0.1 foot. This must hold good between adjacent benches and also between the origin and any bench.

Always establish a substantial and permanent bench at the initial point in all surveys, and note whether an assumed elevation or a sea level datum is used. B. M's. should be placed frequently, and in no instance over two thousand (2,000) feet apart.

All level notes must be checked at the end of each day's work by adding the back-sights and fore-sights and ascertaining the difference of elevation.

Field Maps

Field maps shall be plotted in the field to a scale of 200 feet to the inch, on duplex paper, or to a scale of 100 feet

to the inch whenever in the opinion of the locating engineer the larger scale is necessary.

The preliminary map must be carefully and accurately made. The skeleton of the preliminary survey shall be plotted by latitudes and departures. This method may be checked by laying off the successive calculated courses and distances from a carefully drawn meridian, using a large protractor, not less than 12 inches in diameter.

All data obtained in the field must be placed on these maps. These maps will be sent to the office of the state highway engineer.

The final profiles on location will be made with a horizontal scale of four hundred (400) feet to the inch, and a vertical scale of twenty (20) feet to the inch. For the purpose of determining the final location and grade line, and for more readily balancing cuts and fills, a profile with a horizontal scale of one hundred (100) feet to the inch, and a vertical scale of ten (10) feet to the inch may be used. These working profiles must be returned to the State office with the final location profile.

A judicious use of the "mass diagram" should be made by the locating engineer before he is finally satisfied with located line and grade.

Short sags should be avoided and in all cases vertical curves should be provided at grade intersections.

A diary must be kept by the locating engineer. Details of each day's work must be entered, giving dates of commencing and completing the survey. These dates will be returned to the State office with the maps and profiles of the survey.

The engineer in charge will forward weekly progress report of work done, and all other items of interest pertaining to the work, on forms furnished for this purpose.

All maps, profiles, preliminary estimates and general records will be completed while the surveys are in progress thus avoiding an accumulation of work at the end of the survey.

Right-of-way

Right-of-way will be at least sixty (60) feet in width. Stations will be uniformly one hundred (100) feet long each, and numbered consecutively. The stakes on all lines must be numbered on the rear face, next to the transit. Mark stakes on alternate line with distinguishing letters, A. B. C., etc. Mark stakes on located lines "L."

Ties must be secured to all township and subdivision lines whenever crossed. Give station number of intersection, angle of intersection, distance along the line to the nearest section corner, or one-quarter section corner. Whenever possible,

make the intersection by running through between the two corners.

On the map of the survey, do not fail to indicate which of the section corners and quarter corners have been located. If note to this effect is not made it will be assumed that the location of same has been approximated, and the corner not tied.

Section ties must be given with reference to the location center line, and wherever corners are found, ties must be so taken that the necessary right-of-way strip can be described by metes and bounds. **This is very important.** The data secured by the survey should be so complete that right-of-way deeds may be made out without any further field work. When the road is located through villages or towns, ties to corners, and secure copies of plats, with dates, certificates, etc., and send to office of state highway engineer.

Tie in all property and land lines, and locate all buildings, wells, fences, etc., that are found within one hundred (100) feet of the line.

Cross sections of slopes will be taken at sufficient distances on each side of the line to allow for necessary changes of line and grades.

Check all angles by needle reading, or by doubling the angle, or both.

Angle points should be indicated by station numbers.

Keep all instruments in proper condition and good adjustment.

Special Structures

Where special structures are required, such as viaducts, large culverts or bridges, or other exceptional work, the locating engineer shall cause the ground to be surveyed and mapped to two-foot contours; scale ten (10) feet to the inch, with corresponding profiles, and submit the same, accompanied by illustrative notes and such suggestions as he may think proper to add, to the state highway engineer, who will thereupon cause a plan to be made for such special structure. Exhibits or special maps of this kind should include high and low water marks, character of bottom or subsoil, and in the cases of railroad crossings, a profile of the same for five hundred (500) feet each way.

The work of the state highway department can be successful only through the hearty cooperation of all of its employes.

Faithfulness and loyalty to one's superiors must exist, not only during working hours but at all times.

Derogatory criticisms of fellow employes in the department will not be tolerated.

The proper location of a highway is of such importance that the engineer in charge of road construction cannot

make a mistake if he selects his best and most capable engineers for this preliminary work.

Often to the lay mind the expenditure of money for preliminary engineering and location is a waste of funds. The highway engineer must give a deaf ear to these complaints, knowing that his worst critics will praise the work after the road is completed if the location has been properly made and the highway constructed according to the plans and specifications.

CHAIRMAN TILLSON: The discussion is now open for the meeting and we will be glad to hear from anybody. There must be many here who have had experience in this work, especially in this western country.

DR. PRATT: Mr. Chairman, there is just a word that I would like to say in regard to location suggested by a statement made by Mr. Roy when he said that in certain instances it was found that after a road had been built for five or ten years with grades running from six to seven and eight per cent. and sharp curves that the engineers of today were finding it necessary to try and change that location; in other words, to re-locate the road. Now in the southeastern states we have the Southern Appalachian mountains which give us elevations from sea-level to fifty-five hundred feet and we are issuing bonds for the construction of our roads; and we have been trying to lay down definite rules and regulations regarding the construction of roads similar to those suggested by Mr. Bowlby of Oregon. We are climbing and re-climbing the Blue Ridge and we are making our roads with no grades over four and one-half per cent. We are taking the same precaution as they do in Oregon in regard to curves. Where we are rising with our maximum grade of four and one-half per cent. and come to a curve we reduce the grade in some instances to as low as two per cent.

Now there has been a good deal said in regard to the use of the roads by the automobiles and that they don't mind a six, seven or eight per cent. grade if we give them sufficient right-of-way or headway, so they can get a start, that they will go up the hill on first gear without very much trouble; but Mr. Roy, I think, pointed out very well that the pleasure automobile is not the only one that is using these roads, for there is the automobile truck that is beginning to use our good highways in all the states of this country, and we seem to leave out of consideration the fact that the horse-drawn vehicle is going to be with us for a great many years to come. Now these vehicles do mind these steep grades, and they do mind particularly a steep grade and a curve at the same time. When we come to

work out for them, as I think it will be done later on, the operating expense of these truck automobiles over highways with steep grades and the sharp curves with a grade at the same time, we will find that it is going to be considered very economical to keep the grades down, especially on curves, much below maximum grade.

There is one other point I want to bring out in connection with location and that is in relation to the issuing of bonds for the construction of roads. As we all know, the location is the only part of a road that there is any possible chance of making permanent; and if we are issuing bonds with which to construct those roads, where they are ten, twenty, thirty, forty or fifty year bonds, it seems to me that the engineer should take the greatest care that there can never any question come up in the future of re-locating the road that has been built by means of a bond issue. No matter what surfacing material is going to be used, it will have to be repaired, and sometimes changed. The character of the surfacing material will depend upon the traffic; but the location should be put in with the idea that ten, twenty or even fifty years hence no question whatever should be raised as to the necessity of changing or re-locating that road. I think we have gone far enough in our highway work and in the study of the highway problems to be able to work out as they have in railway construction certain definite principles in regard to grade, curvature, etc., in connection with the location. (Applause.)

CHAIRMAN TILLSON: Is there any further discussion, gentlemen?

A. D. WILLIAMS (West Virginia): The Chalmers and Pierce-Arrow automobile companies have recently been conducting some experiments on the comparison of grades and surfaces. Their conclusions show that on sand, as compared with a surface of either brick, concrete, asphalt or macadam, a twenty-eight per cent grade on the hard surface offsets a two per cent grade in loose, dry sand. The effect of grades on the torque of the engine is not as important to the automobile owner as the question of surface. One of the most important things to consider in locating an automobile road is the radius of curvature, the sight-line as Mr. Roy has brought out. For instance, you take a car traveling at the rate of twenty miles an hour, meeting another coming at the same rate, those cars are coming together at the rate of 3,520 feet per minute. With a little carelessness on the part of either one the lives of the parties in both cars are very much in danger.

I do not agree exactly with the ideas of some of our engineers on the question of maximum and minimum grade. For instance, while we consider the auto truck and the pleas-

ure automobile now, the old horse for many, many years yet to come will be the item upon which we must base the maximum grade. It has been demonstrated by careful observers, those who have given the problem consideration, that a horse for a limited period of time, can exert forty per cent of his weight in tractive force; then oftentimes for a short distance it is better to place a six or seven per cent grade over a limited distance rather than to make a deep and expensive cut, especially when the finances of the community will only permit of a certain expenditure and the demands of the community call for more mileage of road. (Applause.)

CHAIRMAN TILLSON: Is there any further discussion, gentlemen?

E. I. CANTINE (State Highway Engineer, Oregon): My remarks are brought about by Mr. Benson stating in an address at the exposition that he hoped to see the time when he could go on high gear from the Mexican line through to Vancouver and the Siskiyou Pass. If Mayor Bowly will allow me to correct a statement he made, the controlling grade on the Siskiyou is six and not five per cent. The engineer who was Mr. Bowlby's assistant on that work has continued under my direction on the work. He is an exceedingly bright man and has brought out some experiments which it seems to me might be of interest to you here. I took charge of the work and I asked them why they arbitrarily set six per cent as the controlling grade rather than five, or four or eight, and there didn't seem to be any reason to be given, but in all the work in Oregon except on the Siskiyou the five per cent grade has been used as the maximum controlling grade. Mr. Kittridge, this last summer, when he had the paving operations resumed, had occasion to go up and down that mountain, and he found to his interest and surprise that with his Maxwell machine, a machine of ordinary power, he could operate on the mountain, navigate it on high gear wherever the grades didn't exceed five per cent; but the minute he struck any of the long six per cent grades he had to throw it into intermediate, and to my mind that was one controlling reason why we should hold down to the five per cent grade as far as the automobile traffic is concerned. That was our experience in Siskiyou last summer, that where our five per cent grade controlled for even three-quarters of a mile we could handle it on high gear all right; but where we got near or more than six per cent we would have to throw it into intermediate. (Applause.)

MR. BOWLBY: I might say the reason there was a six per cent grade on Siskiyou Mountain section was due to this fact. Jackson county had started to locate this road before

it was turned over to the state highway department and they had spent considerable money on the preliminary work, and when it was turned over to the state highway department they were very much opposed to trying to use a five per cent grade in the location, and very much against my better judgment we gave in to them and used the work that they had already done, and continued the location of the road with a six per cent grade. I have from the very start regretted that we did so. One of the problems that the engineer is up against all the time is whether or not to sacrifice what he knows is best to the urgings of the local communities and local conditions.

CHAIRMAN TILLSON: Is there any further discussion, gentlemen? Before taking up the next subject I wish to read an invitation from the Department of Commerce as follows:

"The members of the Pan-American Road Congress are cordially invited to visit the exhibit of engineering and physical work by the United States Bureau of Standards in the northwest section of the Palace of Liberal Arts, Panama-Pacific International Exposition. Engineers and physicists are requested to make themselves known to the attendants and learn how to avail themselves of the facilities of the Bureau. (Signed) Arthur W. Gray,
Special Agent in Charge of Exhibit."

I wish also to announce that the congress is in receipt of an invitation from a number of officials, including the mayor, of the city of Rochester, New York, to hold its meeting there next year.

The next paper on the program is on the subject of "Road Drainage and Foundations," by Mr. George W. Cooley, State Engineer and Secretary of the State Highway Commission of Minnesota. Is Mr. Cooley present? His paper is here, gentlemen, and it can be read. I think we will have no trouble in getting through with the program, and as the management seems to have left me without a secretary or acting secretary, if you will excuse the lapse of dignity I will read the paper myself.

Road Drainage and Foundations

By GEO. W. COOLEY

State Engineer and Secretary of the Highway Commission of Minnesota

Most foundation troubles are caused by difficulty of drainage and although the value of proper drainage is admitted by all, it is a fact that road engineers and superintendents will in many cases fail to provide for the elaborate drainage necessary to a proper foundation, for the reason that funds are limited and expensive drainage work reduces the amount of available funds for providing a suitable surfacing. This applies particularly to the great mileage of main rural roads on

which there is an insistent demand by road users for surfacing, with impatience at delay or restriction of work on account of the cost of providing proper foundations.

So much has been written on the subject of road foundations that the whole field of investigation has apparently been covered, but in any work of construction, there may appear some detail or condition for which there is no precedent and which must be met by the ingenuity or ability of the engineer or superintendent in charge. As such problems are generally encountered on the improvement of county and local roads, and are apparently of such minor importance that the information is not published or disseminated, a better general knowledge of this work can be obtained by a meeting at least once each year of those in charge of road work throughout each state. It is the lack of attention to details of drainage and foundation work which causes many of the failures of road surfaces, and the relating of experiences at a meeting of those actually in charge of work, with technical advice from proper authorities, would go a long way toward securing more permanent construction.

We hear a great deal about permanent road work, meaning particularly the different kinds of road surfaces, but experience has taught that the most necessary part of road construction is the foundation and that the adequacy of the foundation controls to a great extent the life of the pavement or surface.

The drainage of a road must be complete. While the cost of carrying water away from the side ditches of a road often seems prohibitive, the expense is always warranted by the better construction obtained. When impossible to provide complete drainage the elevation of subgrade of the road should be at least 2½ ft. above possible high water.

In the Middle West, surface drainage will generally suffice, and a proper design of road section in such cases requires gutters from 1½ to 2½ ft. below subgrade, the variation depending upon the character of the soil. Gutters on grades exceeding 5 per cent. should be paved, and in any case, water should not be carried in road gutters farther than is absolutely necessary.

In providing for cross drainage only permanent, substantial material such as concrete should be used, for the failure of a cross culvert will not only block the drainage, but will damage the road surface and may cause accidents.

In heavy soil, which appears to be saturated, or in which there is seepage, it is advisable to place drain tile. Tile should be so laid that it will intercept the ground water, and it is frequently necessary to place a line at each side of the road with leaders or branch lines from the center of road at 50-ft. intervals. This construction is required on sidehills

which develop springy conditions. Rock filled drains are also used successfully on sidehill work, but are not as efficient as tiling on account of their liability to become partially clogged by sand deposits.

In undeveloped swamp country, the most permanent work is obtained by building the embankment from excavation of a dredge ditch on the upper side of road with an auxiliary road ditch on the lower side. When swamps have soundings of from 2 to 5 ft., the grade line of dredge ditch may be disregarded, excepting as to minimum depth.

In the construction of swamp roads, the top soil is spread first and then sufficient firm material is excavated to provide a substantial foundation. These ditches are dug with practically vertical sides in order to secure the maximum amount of firm material from the bottom, and are of sufficient size to allow for necessary drainage after the breaking down of slopes. The low points in the ditch, where deeper excavation is required to secure material, will fill with sediment after a year or two. It sometimes appears extravagant to make such large ditches on road work, but in new country, lateral drainage is always carried to the road ditches, and should be provided for in advance. There is not much difference in cost, however, between hand ditches and a large dredge ditch on account of the lower unit cost of machine work.

After drainage is secured, the important points in road foundations are to eliminate all vegetable or perishable matter and to build up the foundation uniformly. Dragging and planing the subgrade as it is being built will prevent the waviness of surface which develops occasionally after the completion of a road, and it is advisable to place such requirement in specifications.

Surfacing with gravel constitutes the greater portion of rural road work, and a great deal of money is wasted in not properly preparing the foundation for this surface. Common practice has allowed the placing of gravel to a depth of from 6 to 8 ins. on clay or heavy soil, frequently on a newly shaped roadbed. Until compacted, this coat of gravel serves as a sponge, holding the water until the subgrade is softened, thereby allowing the material to be cut through and much gravel lost, with a consequent rutted and uneven condition of surface.

Foundations for gravelling should be firm and hard and on new work this may be accomplished by forming a crust with a mixture of 2 or 3 ins. of sand or gravel with clay subsoil, rolled to a smooth surface. On sand subsoil, it is equally necessary to have a foundation to prevent loss of gravel and in such cases clay mixture is required.

To prevent loss of surfacing gravel on sand a subgrade, where no clay was available a blanket of vegetable material

has been used with complete success. In some cases this has been provided by spreading about 4 ins. of loose straw for the full width of the proposed surfacing, but care must be exercised to prevent the straw from mixing with the gravel. Muskeg or pulverized peat has also been used to advantage under like conditions.

The foundations for higher types of road surfacing, such as concrete, require even more attention than for gravel or macadam roadways. The material must not only be firm, with adequate provision for drainage, but the subgrade must be thoroughly drained out before the pavement is placed. Most of the cracking and failure of concrete roads has been due to moisture in the subgrade at the time frost sets in, and this has frequently occurred where tiling was laid and the road built during the latter part of the season.

The success of any road is dependent upon the complete drainage and uniformity of material in the subgrade or foundation, and it would seem that road authorities could well afford to devote some attention to educating the public along this line, for a knowledge of the necessity of such work is required to secure public support, without which the work cannot proceed intelligently or economically.

CHAIRMAN TILLSON: The discussion on this subject was to be by Mr. Compton, chairman of the paving commission of Baltimore, but the paper discussion has been written by Mr. Frank K. Duncan of Mr. Compton's office, and if you will permit another lapse of dignity I will be obliged to read this also.

Road Drainage and Foundations

Discussion by FRANK K. DUNCAN
Assistant Engineer, Paving Commission, Baltimore, Md.

Considering this topic from a city street paving point of view, it is apparent that the drainage of the subsoil is not a serious problem or of such vital importance as it is in road construction, owing to the fact that very little water finds its way from the surface to the sub-foundation in a city that is properly paved and sewered. When railway tracks are in a street surface, water is bound to find its way along the rails to the subgrade, and if stone or gravel is used as ballast this will act as a drain, carrying the water to the sumps in grade, which points should be properly connected up to the storm-water drains, and of course whenever underground streams or springs are encountered they must be treated in the same manner. In cities having streets so low as to be affected by tides or which are below adjacent water, the drainage problem becomes one of special study and treatment.

On the foundation of a city street depends its stability, the permanence of its good condition and economical main-

tenance. It should be such as is capable of sustaining the traffic and distributing its weight over a sufficient area of the yielding soil beneath. In the preparation of the sub-foundation or the soil, all soft and spongy material below the subgrade should be removed and replaced by good earth, carefully rammed, and care should be exercised during the grading so that the sub-foundation will not be disturbed below the subgrade. It should be hard and compact, and to insure this should be well rolled with a steam roller. This is often thought unnecessary, but if this is done the roller will find the soft spots and old and recent excavations for underground structures which have been improperly backfilled. These trenches are often the cause of failures in well-constructed pavements.

The importance of backfilling of trenches is not always appreciated, especially when the work is done, not under the direction of the paving engineer, but by a disinterested contractor or department having the underground work in charge. The specifications for laying of sewers, water, gas and other pipe, should contain a special clause governing the backfilling of the trenches, and the inspection should be rigid and the specifications thoroughly enforced. Trenches made before the paving, and cuts made after the paving has been completed, when refilled should be hand-rammed, two men to every shoveler, or puddled with water when the soil is pervious, which will allow the trench to drain and become dry and compact. When the concrete base has been cut and is being restored, the old base should be cut back from the trench on either side, so that the new base over the trench will have a bearing on the original soil, and if the ditch is a wide one, steel reinforcement costs little and adds greatly to its strength. This extra care and expense will more than be justified by the permanency of the repair.

The real foundation for the paving is the base, and while there are various kinds, most of them have proved failures. The only one which seems worthy of considering is the ideal one, concrete, which, when well laid, is a permanent asset. The economical thickness of this base to support the pavement is a question on which the engineer must exercise his best judgment and experience. The points to be considered in fixing the depth of the base are the nature of the subsoil, the kind of traffic, the paving material to be used and the width of the street to be paved.

Bituminous paving, other conditions being equal, requires a greater depth of base than either brick or stone paving, on account of the latter materials, when paved monolithic, having considerable strength and distributing the load over a greater area than the soft and pliable bituminous pavement, which has no inherent strength and transfers the pressure directly to the base. Slow moving traffic requires less depth

of base than fast, as the impact of traffic is not so great from the slow-moving team. Narrow streets, paved with a crown and with curbs on either side, owing to the arching effect of paving, will sustain a greater load than a wide street, hence less thickness of base can be used for narrow streets and alleys.

The paving in and adjacent to railroad tracks is the most difficult to keep in repair in the city street, and the foundation becomes one of the utmost importance, for no matter how carefully the paving is laid, if the rails move, due to the passing of cars, the paving will soon go to pieces. Gravel or crushed stone, placed under the ties for a depth of about 6 ins., well tamped, makes a good foundation, but the ideal condition will be realized if crushed stone, of such a size as will be held on a 1½-in. screen and will pass a 3-in. screen, is well tamped under the ties, bringing the track to the proper alignment and grade, and then the interstices in the stone filled with a cement grout in the proportions of about one to three. A concrete base will then be obtained which will make the track very rigid. This method has been used in Baltimore during the past year in the laying of about 10 miles of tracks, and the result obtained has been so satisfactory that this manner of construction is well worthy to be considered as a standard foundation for all paving laid between railway tracks. Its great advantage is that the best kind of a foundation is obtained without interfering with the operation of cars.

The conclusions arrived at, from the observation of the laying and the maintenance of over 100 miles of various kinds of paving laid since 1902, are that unless some unusual conditions exist at the time of the laying of the concrete base, it need never be over 6 ins. thick, and most streets only require a 5-in. base, and alleys and small streets need only a 4-in. base. When the concrete is well laid in proportion of about 1 part cement, 3 parts sand and 6 parts stone or gravel, experience has taught that no paving base has failed due to lack of its depth, except over improperly filled trenches and improperly constructed sub-structures.

CHAIRMAN TILLSON: This brings the subject before the meeting, gentlemen, and it is now open for general discussion.

MR. WINN: I would like to ask one question so that any of the engineers in discussing that paper might touch on it. Where the crushed stone is put under the ties and the gravel is poured, is it necessary for the cars to be kept off that pavement or off the track until that gravel has set up?

CHAIRMAN TILLSON: Can anyone answer the question?

MR. CANTINE: Ordinarily I would say yes, but I had occasion a year or two years ago to put a concrete floor over the viaduct going over the Southern Pacific tracks leading out to Reed College. There was a conference similar to this that week coming on and they didn't want traffic interrupted for real estate reasons or otherwise. I told them I would try it out and experiment, so between the tracks on the viaduct over the street I put in a slab four feet wide of reinforced concrete. The trains of the Southern Pacific were passing all the time underneath, causing the vibration below and the street cars were going straight along. When we came about our work six weeks later we took that piece out and it was absolutely as good as any. The vibration of the traffic apparently had not hurt it at all, but of course in ordinary practice I should say where it is possibe, keep the traffic off.

CHAIRMAN TILLSON: Is there any further discussion?

MR. CANTINE: Mr. Chairman, there is one feature of drainage we have had some experience with in Oregon this last summer. It is a truism that when we were students in college we were instructed what to do in the matter of drainage. Down on the Columbia river and also on the Siskiyou Pass last year we had some two or three miles that you couldn't get through with a saddle horse, so we went down with our drains two and one-half feet below the road and filled it up with rock. Mr. Bowlby knows the situation. I think that feature of drainage ordinarily in Oregon at least is not given the proper consideration. The way a man does if he has a bad hole, is to start hauling rock and he may put in six inches or two feet of rock until he gets that hole filled up; but the ordinary road maintenance man does not put the emphasis or does not realize what proper drainage is. This came on very quickly last year. We want to dig our ditches and fill up our rock drain so that those ditches won't get clogged up and filled up.

MR. WILLIAMS: I do not want to take much time in this discussion, but during the past year we have had some experiences I think in connection with foundations that are worthy of note. The first is that leading out of Charleston, West Virginia. Kanawha county constructed a piece of Warrenite road, sixteen feet wide, upon the specifications prepared by the company on a four-inch base 1:3:6 mix. After six months of traffic—the kind of traffic that came on to the road after the road was approved—this base proved to be insufficient. The road cost thirty-three thousand dollars per mile and the surface on nearly a mile of this road had to be relaid because of insufficient base. At the time the road was being laid the state highway department had noth-

ing to do with it except in an advisory way, but we made a suggestion that the base should be five inches and that the mix should be richer than that which they were using. The company who was putting it in said they were putting it in under a ten-year guarantee and that they would stand the expense. They are now resurfacing the road at a loss instead of a profit.

Another question that has troubled us considerably in connection with our drainage is mountain seepage in its various forms. We have elevations ranging from six hundred feet to five thousand feet above sea level and in those seepage places we find that the best remedy is to make a ditch parallel to the road upon the upper side, placing an ordinary farm tile in the bottom of the ditch, then filling the ditch to the top with crushed stone, bringing the stone completely to the top and putting no earth over it. At intervals this is carried across the road for outlets.

CHAIRMAN TILLSON: Is there any further discussion, gentlemen? If not, we will pass on to the next subject, "Highway Bridges and Structures." The first paper is by Mr. W. S. Gearhart, State Engineer of Kansas.

Highway Bridges and Structures

By W. S. GEARHART

State Engineer of Highways and Bridges, Kansas

Throughout the states of the Central West from 40 to 75 per cent. of all the highway funds collected is expended for the construction and maintenance of bridges and culverts. The amount expended for new bridges and culverts on new sites is very small, so that practically all of these expenditures should properly be charged to maintenance. The constant drain on the public funds for renewing wood floors and stringers and bridges built of light steel is very great, and the flood damage to these temporary structures is enormous.

During the floods of 1915 several Kansas counties lost from 60 to 70 bridges each, and some 700 structures were damaged in the state. It will require approximately $700,000 to repair and rebuild these bridges.

In central Nebraska along the Platte River it is reported that every bridge for a distance of 75 miles is now out and in Texas it is estimated that the county bridges and roads were damaged to the amount of nearly a million dollars in the floods during April and May of 1915. It is also estimated that the Ohio Valley flood of 1913 damaged the highway bridges in Ohio alone to the amount of about $8,000,000.

In the Kaw River flood of 1903, 16 of the 17 large highway and railroad bridges at Kansas City were wrecked in two hours' time by the drift which piled up against the super-

structures and lifted or pushed them off their foundations. The damage to these 17 bridges amounted to about $1,500,000. The indirect losses due to the interference with traffic, the delay in marketing farm crops and the suspension of business cannot be estimated. These losses, however, where the river bridges are out are always very great for it requires at least six months to one year to rebuild them.

In the past twelve years Kansas has sustained a total loss on highway bridges alone conservatively estimated at $3,000,000.

Forty years ago practically all of the highway bridges were wood pile structures, but about that time a large number of metal bow-string bridges known as King arches were built over the larger streams. These arches were well built and were supported on stone masonry abutments and piers. The footings of the foundations were carried a safe distance below the bed of stream. No piers were used in the main channel unless a span of more than 200 ft. was required. The natural or normal channel was completely spanned, the superstructure placed above high water and adequate waterway was provided. Hundreds of these old bridges are in use today. The metal superstructures are light and will not safely carry modern traffic, but the foundations were properly built and ample waterway was provided and as a result the public has had the continued use of these bridges since they were opened to traffic.

About thirty years ago the first light steel highway bridges so common everywhere today, were built. Almost from the beginning the design, construction and material used in these steel bridges have apparently continued to become more defective and the method of handling the work little more businesslike. For more than a quarter of a century the bridge agents have been permitted or requested to design and construct the highway bridges without restraint and the public is now reaping the reward for its indifference. Fortunately, however, the method of handling highway bridge work is rapidly changing.

The following is a typical example of the results of the kind of bridge building referred to above. In the year 1900 a light steel bridge 800 ft. long with cylinder pier foundations was designed by a bridge agent and built over the Kaw River in Kansas at a cost of $14,000, and in 1903 it was partially destroyed and repaired at a cost of $8,000. In 1907 it was partially destroyed and repaired at a cost of $9,000, and in 1910 it was again partially destroyed and rebuilt at a cost of $8,000. The initial failure was in the foundation in each case. During these ten years the bridge cost $39,000 and four years out of the ten it was closed. With an original outlay of about $35,000 a bridge could

have been built which would have withstood any of these floods.

These failures have been due to the use of poor materials, improperly designed and poorly constructed foundations, placing the superstructure too low and providing inadequate waterways. However, these faulty designs and failures have been primarily due to the lack of competent engineering supervision and to insufficient funds to cover the first cost of a properly designed, well-built and thoroughly protected structure.

When the conditions are such that all of the water from a given drainage area must be carried under the bridge the required waterway area can be determined approximately if the size, slope and character of the drainage area are known. From the United States topographical maps the area of the watershed can be determined with reasonable accuracy in many cases. The accompanying table gives the waterway areas, for different sized drainage areas, used by a number of the principal railroads in designing their drainage structures in Kansas, Missouri, Oklahoma, Arkansas, Nebraska, Iowa, and Illinois. Years of experience have demonstrated that these tables when used with due consideration for the local conditions are an excellent guide.

In the prairie country the natural stream channels will not ordinarily carry all the water and in flood time the whole bottom is overflowed. Generally no attempt is made in constructing and maintaining highways in these valleys to throw up an embankment above the natural ground level or above the high water as the railroads have done, except at the bridge approaches. This condition does not affect the height at which the bridges should be located, but it does make it impracticable and unnecessary to carry all of the flood water under these structures. It also renders any drainage area tables more or less useless and complicates the problem of deciding the proper length of bridge to use and the waterway area to provide.

It has been the writer's practice under such circumstances to design the bridges with sufficient length to span the natural or normal stream channel and to provide enough waterway area to carry the maximum flow or capacity of such channel, to place the bridge at an elevation well above high water, and to use no piers near the center of the main channel if they can possibly be avoided. It must be remembered, however, that the bridge and its approaches should be designed in such a manner as to obstruct the stream a minimum amount; for any congestion or damming up of the water may endanger the bridge, cut out the approach fills and damage private property. In every case the local conditions require keen engineering insight and judgment.

AREA OF OPENINGS REQUIRED FOR DRAINAGE AREAS.

Union Pacific

$C = \frac{2}{3}$ to 1 for steep, rocky ground.
$C = \frac{1}{3}$ for rolling.
C = 1/6 to 1/5 for long, narrow, flat valleys.
$W = C.A^{\frac{3}{4}}$.

Acres Drained	C. B. & Q.	Dun's table used by Santa Fe & C. R. I.	$C = 1$	$C = \frac{2}{3}$	$C = \frac{1}{3}$	C = 1/5	C = 1/6
10	2.0	3.2	5.6	4.0	1.9	1.1	1.0
20	4.0	5.9	9.46	6.0	3.15	2.0	1.6
30	5.5	8.4	12.8	8.5	4.2	2.6	2.1
40	7.0	10.9	15.9	10.6	5.3	3.2	2.7
50	8.0	13.4	19.0	12.7	6.3	4.0	3.2
100	14.0	25.9	32.0	21.4	10.7	6.4	5.4
200	24.5	45.7	54.0	36.0	18.0	11.0	9.0
300	34.0	64.4	72.0	48.0	24.0	14.4	12.0
400	42.5	76.0	92.0	62.0	30.7	18.4	15.4
500	51.0	87.0	165.0	70.0	35.0	21.0	17.5
1,000	100	156	178	120	57	36	36
2,000	160	312	260	166	83	52	42
3,000	210	435	400	266	133	80	67
4,000	252	522	510	340	170	102	85
5,000	292	595	540	360	180	108	90
10,000	482	853	1,000	866	333	200	167
20,000	740	1,205	1,758	1,200	600	350	300
30,000	965	1,470	2,240	1,500	750	450	375
40,000	...	1,685	2,900	2,000	1,000	580	500
50,000	...	1,876	3,320	2,200	1,100	664	550
100,000	...	2,716	5,630	3,740	1,870	1,126	935
200,000	...	3,696	9,500	6,400	3,200	1,900	1,600
300,000	...	4,453	12,800	8,600	4,300	2,560	2,150
400,000	...	5,130	16,000	10,600	5,300	3,333	2,650
500,000	...	5,728	18,700	12,600	6,300	3,780	3,150
1,000,000	...	7,870	31,700	22,000	11,000	6,340	5,500
5,000,000	...	....	105,000	70,000	35,000	21,000	17,500

NOTE: Dun's tables were prepared from observations of streams in southwest Missouri, eastern Kansas, western Arkansas and the south central portions of Oklahoma. In all of this region steep, rocky slopes prevail and the soil absorbs but a small percentage of the rainfalls. It indicates larger waterways than are required in western Kansas, the level portions of Missouri, Colorado, New Mexico and eastern Texas. These tables are based on data gotten from different western railroads and from actual surveys and on a 6-inch rainfall in 24 hours taken from government statistics, with the understanding that most of it falls in 6 or 8 hours with a run-off of 172 cu. ft. per sec. and a velocity of 4 miles per hour or 6 feet per second.

An inspection of the old bridges on the stream above and below the new site may furnish some valuable data, but too much reliance should not be placed on the length of spans used and the amount of waterway provided at these old bridges in determining the dimensions of the new structure, for by following the stream a few miles it is not uncommon to find the lengths of the different highway bridges and their waterway areas varying 100 per cent. to 400 per cent. under practically the same conditions. These variations are largely due to the amount of funds that were available when the different structures were built, the whims of the different officials who had charge of the work at the time, the local materials available at the bridge site. Other local conditions of course played an important part. For in-

stance, when a persistent farmer or two owns the land on the up-stream side of the proposed bridge there is always a strong tendency to increase the waterway and the length of the structure.

By inspecting the stream channel for a mile or two above and below the proposed bridge site and taking a number of cross sections the natural or normal channel area can be determined. From this and the other known conditions the length of span required can also be determined.

The height of a bridge over a stream of this kind is even more important than its length or waterway area, and the high water marks are generally difficult to locate accurately. The old residents can furnish valuable information concerning the height of different floods, but the elevations given should not be accepted as accurate until checked by some other means. Marks or indications can generally be found about the old bridges and elevation given on these old structures by the local people are much more accurate than the elevations designated by them on trees, posts or other objects.

Drainage tables should be used as a check when there is any doubt about the information available.

Where the stream will probably be leveed in the near future it may be advisable to design the bridge abutments so that they can be altered at small cost and used as piers.

In the arid country the highway bridge problem is a serious matter, even though many of the stream beds are dry most of the time. The streams generally have a heavy fall, the rainfall is violent and the percentage of run-off very large. The floods come like torrents and in a few hours are gone. The Russian thistles accumulate in the ravines in great quantities and during floods the streams carry tons of this debris. It is impracticable in many cases to bridge these streams with a high structure on account of the lack of funds, the difficulty in maintaining the approach fills and the danger of the structure being swept away by accumulations of drift—Russian thistles.

These stream beds are sandy and cannot be forded without great difficulty. There are no ice floes so that low water wood pile bridges have been used successfully for these crossings. Concrete and reinforced concrete pavings have also been used, but it is the writer's observation that they are not satisfactory because the pavings undermine and break up, even when deep curtain walls are used on both the up and down stream sides of the paving.

The writer designed and supervised the construction of a low water reinforced concrete slab bridge at Ashland, Kansas, in 1910. The length of the structure is 60 ft. over all, and it is composed of two plain concrete abutments, two piers and three reinforced concrete slabs. The clear width

of the roadway is 18 ft. The footings of the abutments and piers were carried about 5 ft. below the bed of stream and into the soapstone from 6 to 12 ins. to prevent undermining. The wing walls were carried well back into the bank.

The bottom of the slabs is about 16 ins. above the bed of the stream and the total height of the bridge above the bed of stream is less than 3 ft. The opening underneath is just high enough to carry the ordinary flow and to permit the removal of any accumulation of debris, and the top of the bridge is below the elevation at which the stream carries drift. In other words, the water flows over the top of the structure before the drift begins to run. Otherwise the bridge would act as a dam and there would be large quantities of drift to remove after each flood and the approach fills would be cut out. This bridge has been under 10 to 12 ft. of water five or six times during the past five years and it has not been injured in the slightest.

The floods are of short duration so that the bridge is never under water to exceed from six to ten hours at any one time, and this does not occur more than once or twice in a year. The actual cost of this bridge was $1,220. A high steel bridge would have cost not less than $2,500. At the present time there are ten or fifteen of these low water reinforced concrete slab bridges in the state and the writer has just completed plans for another one 574 ft. long, to be located across the Cimarron River in Morton County, Kansas.

Where the steel highway bridges have been placed well above high water so that the drift could not pile up against the spans, and the superstructures were securely anchored to the foundations practically all of the flood damages have been due to the use of improperly designed and poorly constructed tubular piers or steel leg and mud sill foundations. The ice floods have been particularly disastrous to this type of foundation.

A few stone and concrete foundations have failed where the footings were shallow and no piling was used. If the abutments and piers are carried down to bedrock or well into the stream bed, and are supported on piles and designed and constructed in accordance with good engineering practice, the losses due to foundation failures will be very slight.

After the 1903 flood in the Kaw River Valley, Dr. J. A. H. Waddell, consulting engineer, Kansas City, Missouri, published a detailed report of the condition of the 17 bridges at Kansas City referred to above, in which he states: "The only set of solid concrete piers in the river were those of the Kansas City Southern Railway Company's bridge at Ohio Avenue. These piers were located near the mouth of the

river, where they were struck by all the debris, but they were practically uninjured." He further states that, "concrete piers of proper dimensions will withstand without injury any such floods."

Many examples of reinforced concrete bridges having spans of 50 ft. or less could be cited which have been entirely submerged in violent floods without injury except the washing out of the earth approaches. These approach fills can be protected by concrete or stone masonry retaining walls or by riprapping the side slopes.

The stream banks immediately above the highway bridges are seldom protected and much damage is done in the alluvial valleys by the water cutting around the bridges or forming new channels. This can be prevented effectively by the use of jetties to direct the current under the bridge and by revetment to prevent erosion.

To reduce the highway bridge expenditures a better system of financing should be provided to meet the higher first cost of permanent structures. This extra expense, however, will not average to exceed 30 per cent. more than the prices now paid for temporary structures. The plans and specifications should be prepared by expert engineers employed by and representing the public, not some special interests, and they should be approved by the state highway department and the work carried on under the direct supervision of a competent engineer. The necessary funds can in most cases be provided readily for permanent bridges if the expense is distributed over a period of years not exceeding thirty. It has been demonstrated that the issuing of serial short time bonds, or capitalizing the resources of a community, for public improvements is good business, and if the same policy were followed in the construction of permanent highway bridges and culverts the enormous expenditures for the maintenance of these drainage structures could be practically eliminated in from ten to twenty years. Since the bridges and culverts must be maintained if the roads are to be used at all, and since they can be made permanent, why not build them right and do it now, and have the use of safe, economical structures?

CHAIRMAN TILLSON: The next item on the program is a discussion on this subject by Clifford Older, bridge engineer of the state highway department of Illinois.

Discussion by Clifford Older

Bridge Engineer, Illinois Highway Department

That very large sums of money are annually spent in the United States for the repair and renewal of poorly designed

highway bridges is beyond question. It is also a clearly demonstrable fact that the greater part of this expenditure may, in the future, be rendered unnecessary by placing the design, construction and maintenance of highway bridges under competent engineering supervision.

The avoidable annual expenditure for highway bridge purposes can only be estimated, as exact figures are not obtainable. Illinois spends annually about four million dollars for highway bridge renewal and maintenance, and this figure is about one-half of the ordinary road and bridge fund of the state. Iowa reports for the same purpose the expenditure of more than five million dollars for 1915, which is also about one-half of the road and bridge fund of that state. Kansas and Wisconsin also estimate that about one-half of the ordinary road and bridge fund is expended for bridge work.

If this proportion holds true for all other states, then of the two hundred million dollars annually expended in the United States for roads and bridges, aside from state aid work, approximately one hundred million dollars is expended annually for highway bridge purposes.

Data collected by the Illinois Highway Department plainly indicates that, had all highway bridges built in Illinois during the past twenty years been designed and constructed in accordance with the best engineering practice of the period, considerably more than one-half of the present annual expenditure for bridges would not be necessary.

As an illustration, the "king arches" mentioned in Mr. Gearhart's paper were probably designed as well as engineering practice of fifty years ago would indicate as necessary at that time, and as a result, the average life of these structures in Illinois has been fully fifty years. In contrast to this distinctive record, the average age of all old highway bridges now being replaced by more permanent structures is less than fifteen years. This illustration seems to indicate that the number of bridges renewed each year may, in the future, be reduced to one-third of the present figure.

Assuming, however, that competent engineering supervision of highway bridge construction and maintenance may eventually make possible a reduction of one-half in these items, the saving for the United States, as a whole, may conservatively be placed at fifty million dollars per annum.

That it will amply repay every state, in which state control of highway construction is not now exercised, to establish a highway department well supported by proper legislation, is a logical conclusion.

A brief review of the principal items which swell the total expenditure for the repair and renewal of highway bridges will show the feasibility of making a very marked reduction in the future cost of the bridge maintenance.

Grossly defective foundations, which render the bridges particularly liable to flood damage, are responsible for the greatest number of early renewals. It is a fairly common occurrence, in the office of the Illinois Highway Department, to receive a report that fifty or one hundred square miles of territory have been swept practically clean of highway bridges. A report of an excessive rainfall in certain of the less progressive sections of the state is sure to be followed by a report of a heavy loss to the drainage structures. In other sections, where, due to some original precedent, it has been the prevailing practice to provide stone, and more recently, concrete foundations or complete reinforced concrete structures, flood damage is comparatively insignificant.

Another very important item of maintenance expense is the repairs to the plank floors which, until recently, were provided on practically all highway bridges. This item may be greatly reduced in a comparatively short time by replacing the planks with creosoted blocks on creosoted sub-plank; creosoted sub-plank with a bituminous gravel wearing surface, or even by the use of creosoted plank alone when the traffic is so light as to cause but little wear. In using such floors on old bridges, due consideration must be given to the danger of overloading the superstructure, the expected length of life of the bridge and the character and magnitude of the traffic as related to the cost of maintaining the floor.

New bridges may be provided with any one of the several types of the more permanent bridge floors now available. Considering maintenance, any of the best modern pavements will show economy, when compared with an ordinary plank floor. There may be exceptions to this in districts where timber is comparatively cheap, when the present price only of timber is considered.

Decay is the natural cause of the expense of maintaining old wooden structures and cannot be avoided.

The construction of creosoted timber structures is well worth considering under some conditions.

The rusting of steel superstructures is the cause of a considerable number of bridge renewals and this can easily be remedied by the proper application of protective coatings. Damage, due wholly to excessive live loads, is comparatively rare, except in the cases where the immediate cause of the accident is the rotting of wood or the rusting of steel.

The greater part of the flood damage to highway drainage structures in Illinois, and probably elsewhere, occurs because of the neglect of the most elemental principles of bridge and culvert design and construction, when engineering supervision is not exercised. The substitution of steel "legs," "posts" or "tubes" for adequate masonry foundations is the principal defect. The lack of a sufficient waterway area is compara-

tively of little importance and, in fact, most of the old bridges in Illinois provide very generous waterways. This condition is due partly to the fact that, under the old system of letting bridge contracts, the bidders dictated practically all features connected with the structure, and the theory, "the larger the bridge, the greater the profit," has had much to do with the more than adequate waterways usually provided.

The general policy of the Illinois Highway Department is to provide, in the design of the new bridges, a waterway area large enough to pass the entire ordinary flood flow of the stream. No attempt, however, is made to provide for the extraordinary flood which is not expected to occur more frequently than once in forty or fifty years. The magnitude and frequency of such extraordinary floods, however, are still largely matters of opinion or judgment, although the Illinois Rivers and Lakes commission is undertaking the collection of data bearing on this subject.

The construction of low water bridges which are not expected to pass the ordinary flood flow, should not be approved for well developed agricultural territory, without due regard to the character of the farm products, the future agricultural development of the territory, and the present or possible future use of the road for more than local traffic.

Large areas of Illinois are devoted to dairy farming and truck gardening and many of the principal roads have developed into well defined automobile routes. These conditions make it imperative that the highway traffic be delayed by high water or other cause as little as possible. Except in rare cases, therefore, all new bridges are planned to carry the entire ordinary flood flow through the opening.

Under the direction of the Illinois Highway Department, a bridge survey, which covers about one-half of the area of the state and almost exactly one-half of the road mileage, has been made. A summary of this survey throws some light on the desirability of issuing bonds on a large scale for replacing highway bridges with more permanent structures and is otherwise of general interest.

On 48,426 miles of road were found 97,963 drainage structures of all sizes. The total length of all these structures, as measured along the axis of the road, is 770,000 feet or about 145.9 miles. The average number of bridges per mile is 2.12; the average length of bridge per mile, 16.46 feet and average length of each bridge is 7.76 feet. Of the total number, 1.8 per cent. are more than 60 feet long; 21.8 per cent. have a length of from 9 to 60 feet, inclusive, and 76.4 per cent. are 8 feet or less in length. (See table page 117.)

Of the total number of bridges 9.8 per cent. were reported as needing repairs and 8.7 per cent. as needing replacement at the beginning of the construction season of 1916. As the

survey covered almost exactly one-half of the area and road mileage of the state, the total number of bridges in the state may fairly be assumed to be double the figures previously stated. The percentages, however, should not vary materially. At the beginning of the construction season then, the are in Illinois about 19,000 drainage structures needing repairs and 16,000 needing replacement.

The following table gives the percentage of each class of structure found:

Wood structures	34.9%
Corrugated pipe	18.2%
Vitrified tile pipe	13.0%
Concrete, reinforced concrete and stone masonry	10.1%
Steel superstructures or steel tubes, legs, etc	8.8%
Steel superstructures on masonry foundations	7.2%
Plain steel pipe	3.8%
Wood superstructures on masonry foundations	2.3%
Cast iron pipe	1.7%

The average cost of all bridges built under the direction of the Illinois Highway Department is about thirty-one dollars and fifty cents per foot. The cost of the average bridge, which is 7.76 feet long, would then be about two hundred and forty-four dollars. The average cost of temporary repairs to the old bridges is about one-fourth the cost of a new structure. The cost of repairs to the 19,000 bridges would then be about $1,000,000, which leaves $3,000,000 available with which to replace worn-out structures with modern bridges. This amount would build about 12,000 average structures. As against this there were about 16,000 to replace at the beginning of the season.

It seems evident, therefore, that if modern structures are to be used in Illinois for all replacements, it will be necessary for the next few years to provide a larger fund by issuing township or county bonds, or by other means. If modern structures are used for all renewals, however, the wood and other short-life bridges will quite rapidly disappear, the cost of repairs will decrease, and the renewals may easily be handled out of the ordinary road and bridge fund.

With our present favorable bridge law and considering the progress made in the movement for the construction of only the most permanent bridges, we estimate that in from twelve to fifteen years our bridge expenditures in Illinois will be reduced about one-half.

CHAIRMAN TILLSON: The subject is now open for general discussion. We shall be glad to hear from anyone.

D. H. WHITE (Washington): The gentleman spoke of cresoted wood block or creosoted lumber for the floor of bridges. There has come to my knowledge in the last two years two cases of failure of the bridge as a result of the

creosoted wood block taking fire. In our county the practice is to build those structures with concrete floor, either with asphalt top or natural concrete as a flooring.

CHAIRMAN TILLSON: Is there any further discussion?

JUDGE ALBERT: Mr. Chairman, I am not an engineer, but I have been watching them for over a half a century. My faith was first shaken in the judgment of engineers over sixty years ago when I saw the largest suspension bridge in the world with an anchor thirty to forty feet deep at each end lifted up and then fall down, tearing out the anchors. The engineer had not provided for one thing, that is for holding it down, instead of holding it up.

There is another element of danger greater than floods or storms which has not been touched upon. This refers to the unpretentious short wooden bridge as well as to the steel bridges and the heavier and longer spans, and is brought about by the increased requirements of bridges at this time. This will apply to all bridges, long and short. The old requirement of a bridge built ten or fifteen years ago was lower than the requirement today. The engineer may have been skillful and the work up to the requirements and a very high factor of safety, but such a bridge won't stand the strain of ten, twelve or fifteen tons that is brought upon it by an auto truck. As members of the advisory committee we went the northern and southern course of the state and called the attention of many of the counties to this defect in their bridges. There is liable to be an accident any day because the use of these auto trucks has increased wonderfully. You will find them where you wouldn't expect to see one of them. The farm wagon doesn't carry a load to exceed a ton or a ton and a half, or maybe two tons, but the trucks carry much heavier loads and we may expect trouble from this very source. I think warning should be given to all supervisors and officers who have charge of the supervision of bridges. You can't prevent the coming of the auto truck, but you can prevent catastrophe by strengthening the old and putting in new bridges. (Applause.)

MR. ROY: I never undertake to make a speech, but there is quite a difference between making a speech and saying something. This bridge question has been a live one with me for a good many years. Ten years ago, and a little earlier than that, I had the honor of being the president of the board of public works of my town, Spokane, Washington, which is a city with a rapid stream running directly through the center of it and every street running north and south through the city had a bridge problem. We had some steel bridges and a great many bridges that

we called combination bridges, steel and wood. Some of them began to get old; not very old, because it was a young city, but a good many of those large bridges were ten years old, and from an engineering point of view we began to realize that there was an unknown quantity in each of those bridges. In the first place they were designed lighter than they should have been for the traffic of today.

One Sunday morning, about six o'clock, my telephone began to ring. It disturbed me, and finally I got a little out of patience and decided I would get up and see what was wanted. One of our principal bridges within four hundred feet of the city hall had collapsed just as a street car passed over it. Just as the street car got off, the bridge fell into the Spokane river. Now, that bridge had been very carefully inspected just two weeks before that and we all thought that we had a fairly safe bridge at that point. Well, I went immediately to the bridge and began an investigation to see the cause. Of course, immediately after that, being right in the center of the city, pressure was brought to bear for the re-building of that structure, and I immediately went to work and built a temporary trestle across that river and asked the city council for an appropriation for a new bridge. Of course, the question was, what kind of a bridge we should have. We had our steel interests to come there, the cement men and their interests, but I insisted that when we built that bridge we should build a permanent structure that would take care of the traffic for all time and that we should build it out of concrete so that there would be no question as to the durability. After investigation and getting the experience of everybody we were confident that that was the material we should build our bridges out of to make them permanent.

Leading up to that I want to tell you that every time there was some unusual demand for carrying a load across any one of these bridges they had to come to the city hall and I had to issue a permit to let this load be transported across the bridge. That practically made me personally responsible when an unusual strain was put on one of these bridges. That was one of the first points that woke me up to the fact that this traffic of ours is continually increasing and that the bridge over which this traffic is placed should be of such strength as not to limit the traffic on the highway. This meant in the city of Spokane a fight for an appropriation sufficient to build a concrete bridge. Now, another thing that was important which developed during that investigation was that when we came to select the material for a bridge we found that a bridge that would carry unlimited traffic could be constructed at that time of concrete as cheap as of any other material in the world.

The vibration and everything of that kind was absolutely eliminated. When a man went across our bridge with a load it didn't make any difference what the load was, he could go with just as much confidence as he could go over any other part of the road. That is what I insisted we should have in the city of Spokane.

It was a two years' fight. It took me two years. I started practically single-handed and wound up by securing an appropriation from the city council to build this bridge of concrete, and from that time until the present day there has never been a bridge built in the city of Spokane of any other material. Those structures, I am satisfied, unless there is some unusual and unforeseen condition, will be as good a hundred years from now as the day they were built. I believe that in taking care of this bridge proposition that has been so ably presented here we ought to look to the fact that we do not restrict the increase of traffic on these roads. We are fortunate in our highway department in having a governor that insists on permanent structures and the highway commissions and engineers have the hearty co-operation and assistance of our highway board, which is composed of the Governor, the Treasurer, the State Auditor, and the Highway Commissioner. When it comes to the question of putting in permanent bridges on our highways, unless there is some condition of finance, something that is impossible to handle, or some condition of transportation in getting the material on the ground, we are building concrete structures. We hope to increase as time goes on the proportion of these permanent structures in our highways. (Applause.)

MR. KENNEDY: While on the subject of bridges it would be a good point to bring out that plank guard rails and fences for approaches to bridges should be built, because in some parts of the country county engineers are apt to disregard the fact that they deal with human nature, and human nature covers our whole subject. Some are careless in driving on the approach of a bridge and a safeguard of that character should be put on small culverts and short-span bridges. It would be a good point to make a rule in all work of that character.

MR. WILLIAMS: Mr. Chairman, Mr. Roy has brought up a question there that I don't like to see go by without a little thought being spent on it. That is the concrete bridge. Mr. Roy speaks of a concrete bridge as being a permanent structure. I wish to say that it is when it is properly designed and properly superintended in construction; but if improperly designed and faulty in the superintendence of the construction, both in the mixing of materials and in the manner of mixing and placing it, it is far from

a permanent structure. We have had some concrete bridges in West Virginia to fall down; in fact, there is one now that is being repaired where a certain contractor failed to put in the proper foundation. When he removed the supports from beneath the bridge, one of the piers settled four inches, another two inches, and the result was that each span of the wall had to be removed, and the contractor has to go underneath those piers and build up a new foundation at a cost practically equal to what he was to get for the bridge.

MR. NICHOLS: I wish that the officials in reporting on the cost of bridge construction would segregate their costs a little more for the benefit of other people concerned in the building of bridges. We find in Arizona it is very hard to meet some of these costs that are being reported from other states. It seems to me that it would be a mighty useful thing if everybody reporting would separate his cost prices a little more, give us the superstructure, the piers, the excavation into dry and wet and a few other little things like that.

CHAIRMAN TILLSON: Is there any further discussion? If not, before the meeting adjourns, I would say that I have been requested to announce that the members of the American Association of State Highway Officials are requested to remain for a few minutes at the close of this session. I am making the announcement at the request of Dr. Joseph Hyde Pratt. If there is nothing further to come before this session the meeting will stand adjourned until two o'clock p. m.

An adjournment was then taken until two o'clock p. m.

THIRD SESSION 2:00 P. M.

JAMES H. MACDONALD: As we open this afternoon's session, for the comfort of the gentleman who is going to preside, I must relate a little anecdote. The celebrated painter, Stewart, was requested by an intimate personal friend of his to kindly let him know how it was that he had such a splendid perspective and that he made all his figures stand out life-like. Stewart replied, "I can't tell you that, my friend, because that is the way that I make my living. That is my secret." He said, "Well, I won't tell anybody." He said, "Oh, yes, you will. You will tell your wife." He said, "Well, that will only be three." "Oh, no," said Mr. Stewart, "let me figure it for you. You will know it, and I will know it, and your wife will know it." "Yes, that is three." "No," said Mr. Stewart, "that is one hundred and eleven." According to that mathematical calculation, my friend, Captain Coggeshall is to address an audience of nearly three thousand this afternoon.

(Laughter.) I take great pleasure in introducing Captain Coggeshall, who is the President of the Tri-State Good Roads Association. (Applause.)

(Captain Walter Coggeshall then took the Chair.)

CHAIRMAN COGGESHALL: Gentlemen of the Convention: The local association, the Tri-State Good Roads Association, representing California, Washington and Oregon, I can assure you, feels greatly honored in being asked to have a representative preside over your meeting this afternoon; but as presiding officer at the beginning of the meeting I may be somewhat like the Swede who recently got converted to religion out in Minnesota. He had been converted but a short time when he was asked to preside at a meeting. The meeting got under good headway and by and by his procedure was such that some of the brothers in the back of the room became disgusted and asked him if he would sit down. At that time he was addressing the meeting. He stopped and he said: "I tank I want to tell all the members in the meeting that while they know a leetle more about religion than I know, I tank I love my Saviour better than any son-of-a-gun in the house." (Laughter.) I have been at the meetings that have been held thus far and I have noticed the gentlemen who preside are technical men, men who are thoroughly conversant with good roads and road building. While I wish to state that I haven't that technical knowledge I would assure you that I feel I am as enthusiastic over the subject of good roads as any man at the congress this afternoon.

Gentlemen, we will begin the afternoon session. On the program there is a paper entitled, "Highway Indebtedness: Its Limitation and Regulation," by Mr. Nelson P. Lewis, Chief Engineer, Board of Estimate and Apportionment, New York City. That paper is here on the table before me, but it seems expedient that perhaps we should pass on and lay the paper aside for the present. If it is not read later in the meeting you will have the pleasure of reading it in the published minutes later on. (The paper was read by Mr. A. A. Willoughby of California.)

Highway Indebtedness: Its Limitation and Regulation

By NELSON P. LEWIS

Chief Engineer, Board of Estimate and Apportionment, New York, N. Y.

Debt may properly be incurred by individuals or corporations when there is need for something of such value that its acquisition is justified even though the cash to pay for it is not at hand. The justification must, however, be predicated upon benefit which will be permanent, or which will at least extend over a period of years, and also upon the ownership

of unencumbered property, or sources of income which may be depended upon to provide the interest on the debt and its liquidation at maturity. In the case of individuals their earning capacity may be relied upon to provide the funds to care for such debt; in the case of business, public service, or industrial corporations, increase of business or output made possible by enlarged facilities may be expected to provide such means; in the case of state or municipal corporations the power to levy taxes, either direct or indirect, is their only recourse. Some undertakings of the last named corporations, such as the development of a water supply system, will provide an income which will care for the debt. Others which have as their purpose the protection of public health, education, or recreation, will produce no direct revenue, and the debt incurred must be provided for by taxation.

Highway improvements, whether in rural or urban districts, whether under the control of state, county or town, will produce no direct revenue. Some of them are almost entirely of general benefit, others will involve considerable local benefit, and still others, especially in large urban districts, will be of almost exclusively local benefit. In rural districts the mileage of roads is great in proportion to the number of abutting owners, and the cost of their improvement is very large in comparison with the value of the property served by them. Where land is productive and intensively cultivated and where markets or transportation lines to markets are accessible, the cost of road improvement will be compensated for by the lessened expense of hauling due to the possibility of greater loads and better speed. Where land is unproductive, population sparse, and traffic light, the expense of better roads is beyond the means of the district. In either case traffic is principally local and the township, county or state was not formerly disposed to bear the cost of betterments which did not promise to be of advantage to the entire political unit. The advent of the motor vehicle has changed these conditions. Urban population has spread into the rural districts, improved methods of agriculture with better returns, both in quantity and prices, have placed the motor car within the reach of the rural population, and demands for general highway improvement have become insistent and irresistible. The first response to this demand was through state aid, the cost of road improvement being divided between the state, the county and the township, and in some cases, the abutting land owners. The tendency has been to consider such improvements more and more as of general benefit and less and less a local obligation until the state itself now assumes the larger part of the burden. Whether this work should be undertaken and paid for by the state without local contribution is at least a debatable question.

In towns a few blocks of a single street can be improved at a time and the benefit to the property is immediate. In developing a county or state system of improved highways such slowly progressive improvement will not answer the purpose. The value of the system is directly dependent upon its completeness and the time within which the entire system can be provided. This means a large expenditure within a period too brief to permit it to be raised by general taxation and resort must be had to a loan and that means a highway debt. This seems a very easy way to secure so desirable an end, but the great danger is that the issue of bonds will not be governed by the conservative policies which are usually followed by individuals or business corporations which realize the seriousness of such obligations.

The use of bonds by a state, county or town is justifiable only when, and to the extent to which, the benefit will be general. To impose upon the public at large a burden of taxation for a term of years when the benefit will be chiefly local is obviously unjust, but conceding that a complete system of improved highways is of general benefit to the county or state, and the local benefit is so small as to make a direct assessment impracticable, there still remains the question as to how the necessary funds shall be raised. It is assumed that a loan will be resorted to and bonds will be issued. The question is, shall they be for long terms, or short terms, corresponding with the estimated life of the improvement, or serial bonds. There has been a disposition to issue bonds for long periods, frequently for fifty years. For such part of the work as is really permanent, such as the widening or straightening of old roads, or the improvement of their grades, this may be proper, but for that part of the work which will be short lived, such as the wearing surface of the roads, a long loan cannot be justified.

With interest at four per cent the total interest payments on 50-year bonds will be twice the actual cost of the work. The annual amortization charges for 50 years on a three per cent basis would be 0.89 per cent, so that for every $1,000 of original cost the state or the city would pay $2,445, but the roadway surface will have worn out long before the expiration of the 50-year period, yet the public at large will keep on paying. If this apparently easy way of meeting the cost of highway improvement is once begun it is likely to be continued, and even to be applied to meeting the cost of replacing worn-out surfaces. There are many cases where pavements on country roads and city streets will not last more than ten years, and if this policy of financing is continued the public will, after forty years, be paying for five different road surfaces, of which four will have entirely disappeared, and the annual expense during the decade from forty to fifty years after the

original improvement was made will be 24.25 per cent of its original cost. These estimates relate only to the wearing surface itself and not to the more permanent portion of the work which will have a life much greater than ten years.

Short term bonds when issued for highway improvement may be generally considered as those whose term will approximately correspond with the life of the improvement, so that the road will not be worn out before it is completely paid for. Some portions of the work will last longer than others, and bonds which will correspond in their terms with the average life of the improvement may properly be considered short term bonds. In the case of a highway improvement which is to be entirely paid for by bond issue, if 20 per cent of the cost is represented by such expense as widening, grading, and substantial culverts, that portion may be considered permanent and 50 years would not be an unreasonable time in which to pay for it; if 20 per cent. is for curbing and for gutter paving, which might be expected to last for 20 years, bonds issued for a corresponding term for this part of the work would be fair and reasonable; if the road surface represented the remaining 60 per cent. of the cost and the surface would require replacing in ten years, it would be unwise to borrow the money to pay for that part of the work for a longer period. The average life of the entire improvement might in such a case be considered 20 years, and it might therefore be considered proper to issue 20-year bonds to pay for it. There is a fallacy, however, in this argument, as the interest and amortization charges will be constant for the entire 20-year period, notwithstanding the fact that the part of the work representing 60 per cent. of the total cost will have been worn out in half that time, although there will still remain a portion representing 20 per cent. of the total cost which will last for at least 30 years after it is entirely paid for. A more conservative plan would therefore be to limit the bonds for an improvement of the kind described to 15 years. As the terms of the bonds are shortened the total annual expense grows impressively larger, but it must be remembered that there is less overlapping of the different issues, and after this policy of paying for highway improvements by bond issues has been followed for a period corresponding with the term of the bonds the total amount to be provided to care for the outstanding debt will be considerably less in the case of the short term bonds. For instance, if a constant sum of $1,000,000 a year were borrowed for highway improvements and if 50-year bonds were issued for the purpose, at the end of 50 years there would be $50,000,000 of these bonds outstanding. During this time the annual interest and amortization charge would gradually increase until it reached $2,445,000, when it would remain constant. If, however, the funds were raised by the issue of

10-year bonds there would be $10,000,000 outstanding at the end of ten years, during which time the annual interest and sinking fund charges would increase until at the tenth year they would reach $1,322,000, when they would remain constant. Under the latter policy there would at the end of fifty years be an annual saving to the taxpayers of $1,123,000. It may be said that these periods are so long that such a discussion is academic, but street and road improvements are going to continue for an indefinite time; our states and cities hope to remain solvent and must meet their financial obligations and debts of this kind must be paid in full, so that the actual facts should be squarely faced.

To distribute the cost of street or road improvements over a term of years, and at the same time to avoid the necessity of accumulating large sinking funds which return a small rate of interest, resort is frequently had to serial bonds. In this case provision must be made for retiring a certain part of the issue each year and for interest on the bonds which remain outstanding. If $1,000,000 of four per cent. bonds are issued in serial form, $50,000 falling due each year, the provision which must be made to care for the bonds to be retired and the interest on those outstanding will be as follows:

1st year.....	$90,000
6th "	80,000
15th "	62,000
20th "	52,000

One advantage of this plan is that as part of the work is worn out and the value of the improvement becomes less there is a corresponding reduction in the annual burden. It is important, however, that the series shall be so arranged that the amount outstanding at any time shall not exceed the actual value of the original improvement at that time. When serial bonds are issued in such a manner that the last bond will not be retired for a long term of years or a term far in excess of the probable life of a large portion of the work the plan is uneconomic and pernicious. A striking example of the abuse of the serial bond is afforded by the case of two towns now a part of New York City, which, in 1868, secured legislative authority to improve a highway passing through both of the towns and to issue serial bonds. As these bonds were actually issued the last bond of one of the towns will fall due in 1980, and the last bond of the other town will not mature until the year 2147.

It might be feared that serial bonds would not command as good a price as would those running for a longer term, but at a recent offering of a large number of New York City bonds the bids received for serial bonds, then offered for the first time by that city, actually exceeded the price offered

for 50-year bonds, both bearing the same rate of interest. It is possible that present financial conditions render a more liquid asset desirable, but the fact that the prices bid for serial bonds were better than those for long term bonds was a surprise.

The space alloted to this paper does not permit further discussion of this important subject. Unless state and municipal authorities show a disposition to limit the terms of their obligations more nearly to the life of improvements for which they are to pay, it will probably be necessary to adopt a plan somewhat similar to that followed in Great Britain, where no obligations may be issued by any state, town or county authorities until there shall have been submitted to the Local Government Board a precise statement showing the character of the improvement, its probable life and its estimated cost, when this board will determine the amount of the bonds which may be issued and the terms for which they may run, the purpose being to ensure the extinguishment of the debt within a period which is less than the life of the improvement.

CHAIRMAN COGGESHALL: The discussion of this paper is supposed to be opened by Mr. B. A. Towne, of Lodi, California, but I think Mr. Westerlund is the gentleman who is going to open the discussion on this subject.

MR. WESTERLUND: In explanation I desire to say that the paper I have was written by Mr. W. I. Vawter, of Medford, Oregon. He could not be present. He is our state representative and is a very able man, a man who thoroughly understands the legal part of road building. I regret very much he could not be present, but I told him I would read his paper for him.

Discussion by W. I. Vawter, Medford, Ore.

(Read by Mr. Westerlund)

That the amount of indebtedness incurred in the construction of highways, whether city, county or state, should be limited and controlled must be admitted by all.

Bonded indebtedness for highway construction by state and county is legislation of comparatively recent date. There is no fixed or certain rule or regulation that can be invoked as definite and standard. What is the proper measure as to the limitation of indebtedness cannot be defined from experience of the past. That the amount of expenditure should be controlled and regulated is evidenced by the expenditure of towns where the street paving indebtedness has proven onerous and burdensome.

Perhaps the tendency to extreme conservatism cannot be better illustrated than by reference to my own state.

Oregon was admitted to the Union in 1859. The constitution adopted by the people at that time was especially stringent in its limitations on indebtedness, Section 7 of Article II providing that "The legislative assembly shall not loan the credit of the state, nor in any manner create any debt or liabilities which shall singly or in the aggregate with previous debts or liabilities exceed the sum of fifty thousand dollars, except in case of war, or to repel invasion or suppress insurrection; and every contract of indebtedness entered into or assumed by or on behalf of the state, when all its liabilities and debts amount to said sum, shall be void and of no effect." And Section 10 of the same Article provides: "No county shall create any debts or liabilities which shall singly or in the aggregate exceed the sum of five thousand dollars, except to suppress insurrection or to repel invasion." And these provisions of the constitution placing a limitation upon indebtedness remained unchanged until 1910, when among the exceptions there was added the right to build permanent road, which provision was thereafter modified in 1912 amending this provision of the constitution so as to read, "No county shall create any debts or liabilities which shall singly or in the aggregate with previous debts or liabilities exceed the sum of five thousand dollars, except to suppress insurrection or repel invasion or to build and maintain permanent roads within the county, and debts for permanent roads shall be incurred only on approval of a majority of those voting on the question, and shall not either singly or in the aggregate with previous debts and liabilities incurred for that purpose exceed two per cent. of the assessed valuation of all the property in the county."

The organic lawmakers of that day were not alone satisfied with these restrictions upon county indebtedness, but they especially prohibited the state from passing any law, special or local, for laying, opening, and working of highways, with the result that for more than fifty years practically every effort on the part of the state to aid in highway construction was held by the courts to be unconstitutional.

There was a reason for this particular solicitude on the part of the early legislators against allowing the state to engage in general road construction. The provisional government was the first effort of organized government in Oregon, which in turn was succeeded by the territorial government. Numerous acts were passed by these preliminary governments establishing highways. On December 12, 1846, an act was passed by the provisional government providing for the laying out of a road from the town of Portland to

the mouth of Mary's River in Polk County. Another was authorizing a territorial road to be established from Oregon City to the Calipooya. So many of these special acts were passed establishing these several territorial roads that the debts incurred thereby became burdensome. The territory was sparsely settled; improvements were few; agriculture and stock were the main resources; markets were not good, with the result that the income for expenses in governing the new colony was especially limited, and it was deemed but wisdom on the part of those framing the constitution that a strict limitation or regulation should be placed upon the right of state and county to engage in general or special or local road building. Neither was the need felt by the people of this state for any change until long afterwards.

The period from 1870 to 1900 was a period of railway construction. But scant thought was given to the improvement of the highways and this change in sentiment did not commence to ripen until the advent of the automobile. Even as late as 1909 the legislative assembly passed an act providing for the construction of a state road from a point on the Pacific Ocean to the Idaho boundary by way of Crater Lake, the first section of the road to be constructed from Jackson County, at Medford, to the city of Klamath Falls. The act carried an appropriation of $100,000; $50,000 for use first in the counties of Jackson and Klamath, conditioned upon those two counties each appropriating a like amount. This road, the first leg of which was to be built in Jackson and Klamath counties, past one of the scenic wonders of the world, under the control of the United States government, was adopted by the Legislature with the tacit understanding that the government would expend hundreds of thousands of dollars in the development of a road system within the National Park; but notwithstanding, the courts held it to be a local road of local character, the court saying:

The local character of the act is further indicated by the provision that as soon as Jackson County has made its appropriation of $50,000 to aid in the construction of a road from Medford, Jackson County, to a point on the west line of the Cascade Forest Reserve, on the route to Crater Lake, the Governor shall appoint a commission and thereupon twenty-five per cent. of the sum appropriated shall become available for use in Jackson County and $12,500 each year for three years thereafter, and upon Klamath County making a like appropriation, the same amounts became available in like manner. Each county stands alone. If Jackson County appropriates $50,000 and Klamath does not, Jackson County, at the end of three years, has a county road, the beginning and terminus of which is selected by the State, and practically designated by the act itself. And there the road ends, as it begins, entirely within the confines of one county and is a county road. If Klamath County accepts

the State's offer, we have two county roads, one in each county, entirely beyond the supervision of the State. We think that the constitutional provision invoked in this case was padded to prevent the invasion of the State of the regular method of laying out, opening, working and supervising highways provided by general laws; and that this act violates the constitution in these particulars; First, that it requires the proposed county highways to begin at a particular point; second, that it appoints a commission to supervise not only the expenditure of the sum appropriated by the state, but that appropriated by the counties interested, and to have entire charge of the construction of the road, which is expressly declared in the act itself to be a county road.

It was not until the year 1913 that the state awakened sufficiently from its lethargy to adopt an act creating a highway commission, composed of the Governor, Secretary of State and State Treasurer, and appointing a state highway engineer to have charge of highway construction. The act in question provided that the state, when providing for state revenues, should levy upon the taxable property in each and every county equal to a quarter mill of each dollar of assessable property within each county.

I may add that this taxation raised for state highway construction a sum not quite equal to $350,000 annually. While California has expended upon its highways twenty or twenty-five millions of dollars, and Washington has expended between ten and fifteen million dollars, the state of Oregon has expended from state funds less than the sum of one million dollars.

That there is a genuine public sentiment for road building may be gathered from the fact that some four counties in the State, under the act of 1912, have taken advantage of the authorization to create debt for road building, with the result that Multnomah County has authorized a bond issue of a million and a quarter dollars, which is being used for the building of the scenic highway up the Columbia River. Jackson County, in the extreme south, in 1911 authorized a bonded intebtedness of $500,000, the proceeds therefrom to be used for the construction of a highway from the California line north to the south boundary line of the county adjoining on the north, and Hood River and Clatsop counties have likewise, by a vote of the people, adopted lesser bond issues which are being used for state highway construction.

There is being advocated, and it is only a question of time until it is adopted, a bond issue by the state of ten million dollars, the proceeds therefrom to be used at the rate of two million dollars a year, in the construction of a permanent highway north and south and east and west. This proposition will be placed before the people for ratification at a general election. It is a question whether at the next general election a sentiment sufficiently in favor thereof will

have been created by educational process, or whether the spirit of '59 as evidenced by the state in its constitution is still paramount.

As to limitation, towns and cities in some instances have incurred indebtedness for street and highway improvements from twenty to twenty-five per cent. of the assessed valuation of the town or city. This has proven in many instances burdensome and I believe for a town assessed at five million dollars to undertake to foist upon the inhabitants thereof and the owners of property an indebtedness of one million dollars for street paving is excessive, and the limitation upon the right of a city or town to so encumber itself with debt should be enacted either by the legislature or by constitutional act.

What has been said of the city is true of the county and state. The two per cent. mentioned above is wholly insufficient to properly build and operate a system of state highways unless the counties receive large sums from the state by way of aid. The amount which a county should be permitted lawfully to incur for highway improvement should not exceed from five to eight per cent. of the assessed valuation of the property within the confines of the county.

As to regulation, it is a fact that the life of a highway, under any known system of construction at this time, is comparatively short.

The maintenance of the state highway should be under the absolute control of the state. It should be cared for and maintained at the state's expense, under its highway department, and the act or acts and law or laws providing for highway expenditures should strictly and stringently provide a sinking fund for the liquidation of such indebtedness. A period of twenty years is a sufficient length of time for any bond issue to run, and there should be a sinking fund provided during each and every year by which county indebtedness for highway construction should be fully paid.

Discussion by J. F. Witt, Dallas, Tex.

Indebtedness incurred for the purpose of highway construction is generally conceded to be an act of progress without sufficient thought being given to the value received on such indebtedness, or the returns to be expected from the investment made possible by the borrowed capital.

Long term bonds are made popular from the reason of a smaller annual sinking fund. Short term bonds and serial bonds are, however, often preferred, but the difference in what kind of bond is voted is slight compared to other adjustments that should be made before the money is bor-

rowed. The principal fault is not whether the bonds are 20 year serials or 40 years straight, but lies more in the lack of provision for a fixed amount for maintenance and repair of the highways constructed; thus insuring an improvement that will last with the debt. The only way to make the improvement permanent is a definite and adequate method of maintenance.

Considering a wearing surface in keeping with traffic requirements the nominal sum available for maintenance and repair "without special provision has been made for the same" is inadequate with the result that the wearing surface is worn out long before the invested obligation is discharged.

We may feel that the evolution in traffic in the past ten years will probably be repeated in the next ten years, and in that way make it impossible to pre-determine what fixed charge to make for maintenance and repair. In a manner this is true, but in trying to work out a method that would bring about the result suggested, we will not have to go far to improve on present conditions. Some restrictions should be passed by every state, that would control the issuance of bonds for highway improvement and that would make it as necessary for governing boards to fix a permanent and adequate fund for maintenance and repair, as it is to have an estimate on which to rely for the amount of funds required for construction purposes.

The limitations of borrowed money for highway purposes should be governed by some fixed standard of construction; that standard to be determined by the amount and kind of traffic the highway will have to carry. The necessary number of miles and the layout for the same also enter largely into the question, for aside from cross-state roads that enter into most highway systems, all intermediate roads should be laid out after a thorough study of traffic zones, so that when the system is completed it will accommodate a larger part of local traffic, and not less than probably 70 per cent. of the tonnage of the district that pays the interest and sinking fund made necessary for the construction of the system, thus insuring compensation on the investment. When state aid is furnished, the above plan would probably be modified, but it appears to be about the best method of controlling the expenditure for counties or special districts.

In the matter of levying a special tax for the purpose of taking care of indebtedness created for highway improvement in rural districts, the prevailing plan of making the levy general over the district benefitted appears to be unjust. The method employed in some cities of having the abutting property owners pay for a large part of the pavement cost, appears to be an equitable adjustment that should apply to rural districts as well as to the city—not to as great

an extent, for the special benefit derived would not be so great, but charge the abutting land with the greatest percentage and graduate the percentage down for a distance from the highway that would be governed by the layout of the system, until the minimum was reached, which would be the basis for the general levy applied.

All abutting property receives a greater and more direct benefit from the improvement than does property located off the road. It is therefore unjust to make the charge equal. This method of paying for the improvement would also have a tendency to reduce the present manner of distributing to certain localities a preference brought about largely through political influence, by placing all property benefitted either directly or indirectly on an equal footing, as all property would then receive a benefit in the ratio of what it paid toward the improvement.

CHAIRMAN COGGESHALL: This subject is now open for further discussion.

MR. WHITNEY: I don't want to make a speech, but we have with us today a gentleman from California who has been interested in roads for many years and I know that he is well qualified to discuss this question. He is young and timid, and consequently he will never get up on his feet unless you ask him to, Mr. Chairman. And now I would ask you to please call on Mr. Eddy to discuss this question. (Applause.)

CHAIRMAN COGGESHALL: I can sympathize with Mr. Eddy if he is young and timid, but we shall be glad to hear from him.

MR. EDDY: Mr. President, I think I am timid, all right, but I will get down here where they can all see that I am still young. I do not wish to deceive you or any of the hearers here in thinking that I am an engineer. I am not an engineer, and it is no reflection on the engineers at all that I am not one; nor am I a road builder, and that is no reflection on the contractors; nor am I a capitalist, but that is some reflection on the dear people and myself. My concern in road building in the state of California has been principally in providing one of the elements that is necessary in order to secure good roads. One element, of course, is a competent engineer. The second is a road builder of practical experience; and the third is the money. My experience has been in trying to induce communities and counties to raise the money, and for that I have had experience in ten of the counties of California.

If you will suffer me to explain I will say that in the state of California we have a number of state laws affecting public highways, and here we designate expressly between country highways and city streets. All the highways of

which we speak in this state end at the corporation limits. Therefore anything that I say affects only country highways extending from city to city, or corporation to corporation. I will say that I have had experience in California extending from Los Angeles to Reading and from the summit of the Alpines to the Ocean, to San Mateo county. I know that at least ten counties are now working on road indebtedness effected by good road bonds authorized by the state. In my various experiences in the several counties I never saw a single dollar honestly expended for permanent improvements, which were properly and continuously maintained, that did not yield one hundred per cent. within five years. (Applause.) I never saw a single dollar expended for temporary patching up of old roads that was not a tax and a sheer loss. Now, that is a difference between a tax for roads and an investment for roads, and in every county of California—as I can prove by gentlemen who are in this hall at present—where they have adopted good roads and built them and maintained them, they have increased their valuation, increased their effectiveness, increased in every civic virtue more than double the amount of the bonds.

In some counties in this new commonwealth of California where they have constructed roads of an extensive nature—and they accommodate large areas—I think that the profits have yielded four or five times the amount of the bonds; and if they had gone into the market with their public revenues and sold them out before the roads were completed they might have cashed in the whole indebtedness and done it at a profit. That is something that we can take from the railroads. For instance, in the San Joaquin county, where I chiefly operate, at least the second county in the state, they have three railroads traversing the county which have invested from ten million dollars up, and I have no doubt that they borrowed every cent of the ten million dollars, and possibly to a larger extent than their stock valuation, to build the roads and to get the traffic of that county, every pound of which must first transverse the public road. The county went through and built two hundred and thirty-eight miles of road by bonding itself for one million eight hundred and ninety thousand dollars, for which they sold over two million dollars' worth of bonds, and increased their valuation more than twenty million dollars during the course of construction. Not only that, but they doubled their post-office receipts. They doubled their bank clearings. They doubled everything and every measure, and so has every county in the state that has followed out the state Savage law, which permits the county to bond itself, including the cities, for the improvement of roads from one city to another in the same county or to the roads of an adjoining county.

This is only one phase of the question. In every county I have been in, numbering ten, I have found that there is a superfluity of road engineers. Now, if we want to build a railroad we do not find in that county more than two or three men that pretend that they are capable of laying out a railroad. They don't aspire to the job, but if you want to build a wagon road you will find five thousand men that know just how to do it, and yet a highway engineer is of much higher grade than a railroad engineer or any other engineer that exists, not only because he has to look out for the grade and the curves and the soil and the climate, but a dozen other things that he must adapt himself to, including the local conditions. In fact, I think I esteem a highway engineer as the very top of the profession of engineering, and that is one thing that you have to educate the people up to, that they don't know how to build a modern road. You have got to trust to somebody, and you might as well trust it to an engineer who is paid for the work.

Now, in this state, the ordinary law leaves the construction of the main county highways in the board of supervisors. The boards of supervisors are elected under a state law, which permits them only a half a salary. They have other things to look after, and not one of them is paid to become an expert in road building or anything else; but the Savage Act creates a commission for that express purpose. That commission is authorized to employ an engineer and in most of the cases in this county, and several other counties that I know of, they employ engineers who are graduates of the road bureau of the United States government at Washington, and they get the full worth of their money. Of course, these engineers who had experience there get valuable experience here. But in my judgment every dollar raised in this state by county indebtedness or by state indebtedness or by gift or by taxation, and I will say that there are only two counties in this state, the county of Los Angeles and the county of Alameda, in which we are now, that can afford to do it by direct taxation; but all the other counties, if they improve their highways, must do it by a bond issue and indebtedness. Every single dollar expended has been expended at a profit, and every single dollar that has been distributed on the public highways for patching up old roads is a sheer waste, a tax, and I don't blame the people for voting against it. (Applause.)

CHAIRMAN COGGESHALL: Are there any further remarks on the subject?

JUDGE ALBERT: I am interested in this subject because it is one to which I have given a great deal of attention and one which I think I understand pretty well in relation to

our state, the state of Oregon. In the first place, the fallacy of the argument that has been made against bond issues is, that they have been treated as an expense. You have given the debit side only of the ledger. Now take the credit side. Has there been any benefit?

If you were going to build a railroad, if you wanted a million dollars or five million dollars to build a railroad you would first figure if after that railroad had been built what freight will it receive; what benefit will it be? If you borrowed the money it would be because you thought it would be an investment. So it is with the roads. It was shown here that they were paying three times as much interest as the principal amounted to, but it was not shown what benefit was received. If you haven't been getting revenue from that road that will pay the expense and indebtedness and give you a profit of at least ten per cent you should not have built the road. I think it can be demonstrated any place in the state of Oregon or in California that I know of where they need a road, or are likely to issue bonds for a road, that they would receive at least ten per cent on their investment.

In our state our valuation now is about a billion dollars, and we can issue twenty-five year bonds and amortize them so that at the end of twenty-five years each series of bonds will be paid in full, interest and all, each year paying its share of the cost of the improvement and the interest on it and being liquid at the end of the time. Taking the increase in valuation at one-third of what it has been in the last thirty years at no time will it reach half a mill and that is fifty cents on a thousand dollars. At the end of the time the bonds are all paid off. We need those roads now. It is just like anything else, if you don't have the money you should borrow it. Credit is the cornerstone of the business world.

Take your own city. How many of these skyscrapers or enterprises of any great extent could exist without credit. Credit is the bottom of all. Mills, railroads, canals; the Panama canal itself could not have been built without the government issuing three hundred millions of bonds, or about that amount. Each block of bonds forms the basis of our national bank circulation. The question when you make an investment is, what do you pay for it and what are you getting in return for it? Now, I can demonstrate, if a man is reasonable, that there is not a road that has been built in the state of Oregon or the state of California that does not pay a revenue. It is true the revenue is not paid into the treasury and disbursed again, but it is a more equal distribution of the revenue that you get from the road than if the state had that money in the bank. The state has no capital. Its capital is in the pockets of its

people and the only way that you could build is to use that credit of the state. You take bonds issued by private corporations and they are secured by a mortgage upon all their property, and yet when you go into market as against public bonds the public bonds bring the biggest price. They are not secured. You couldn't sell out a county, you couldn't issue an execution against the county and sell any of its property, yet there is something behind that that makes a bond worth more than anything else. It is patriotism, and it exists because the people of this country won't repudiate an honest obligation that has been incurred legally.

Now, the issue of these bonds is the only manner in which we can have those roads now, as I said before. Put it upon the same basis as the railroad and sit down and figure your traffic as near as you can and you will find that it pays three times the amount that it costs in tax and in revenue. I wish I could have a franchise for a road from the California line on the south to British Columbia. I will give a reasonable rate for the privilege of putting a toll in and there wouldn't be any difficulty about that paying out.

Something has been said about the roads wearing out under the traffic. If the traffic is sufficient to wear the road out in ten years it will pay you to put on a new surface. There is a prejudice against going in debt. There is a prejudice against bonds because bonds have been issued without any arrangements being made for their payment at all. There are many instances where very injudicious indebtedness has been incurred, but we couldn't do without indebtedness; we couldn't do without the issue of bonds because we couldn't get what we want. Then we complain about indebtedness and about paying interest on the bonds—paying taxes to build roads.

If you live in a civilized country and amount to anything you have got to have good roads. That is the only way to get good public roads. There are millions of people in the world that don't pay any taxes. They have no credit and won't trust one another. This country was full of them before the white men came in. They didn't pay any taxes. The roads were good, but they were only about two feet wide. They were on better lines than some modern roads, for their line was the line of least resistance; but these people had no homes, they wore no clothes, never ate bread and slept out-doors. (Applause.)

MR. MEATH: Mr. Chairman, I come from the most northwestern state, where we build roads without a bond issue and think that we are getting along pretty fast at that. In our state the constitution is something similar to the constitution of the state of Oregon, inasmuch as if we were in debt, or owe four hundred thousand dollars, we cannot issue bonds without a vote of the people. There-

fore it would be necessary to have a constitutional amendment. The way we build roads in Washington is that we have four classes, the public highway, the permanent highway—this is under the state and under the counties—the road district and the road and bridge district. In the public highway fund we levy a mill tax which brings in a million dollars a year; the permanent highway fund, a mill and a half, which brings in another million and a half. This permanent highway is built by the counties, but under state supervision. In Washington the highway board is composed of the governor—and, by the way, our governor is an old contractor and enthusiastic road man—the state auditor, the state treasurer, one member of the public service commission, and the highway commissioner. I want to just read you a few statistics of how we have gotten along.

I desire to state, Mr. Chairman, that some of the counties in our state have bonded in various amounts from a hundred thousand dollars up, I think the highest amount being four hundred thousand dollars in King county. This does not include cities or towns. We have in the state of Washington, up to January first, thirty-seven thousand miles of roads composed as follows: Unimproved earth roads, twenty-four thousand and fifty miles; improved earth roads, eighty-five hundred miles; gravel roads, thirty-seven hundred miles; waterbound macadam, three hundred and thirty-nine miles; paved roads, two hundred and eleven miles, and corduroy and plank roads, two hundred miles. For a period of ten years up to April first, 1915, there had been spent on roads $2,796,064 under our present system; and on the road districts, from some county districts, seven mills and from some ten. These are the feeders and they raised on the road districts $2,923,498; on the road and bridge districts, $1,631,689. The permanent highway fund raised by the counties, however, amounted to $1,547,849. The public highway fund amounts to $1,031,899, or a total available for each year of $7,134,935. I desire to state, Mr. Chairman, that we are building roads and are building them fast. We have all of our roads paid for with the exception of these few counties that have bonded. We have under course of construction two hundred and twenty-five miles in the public highway fund and two hundred and fifteen in the permanent highway fund. Our highway board is against the bond proposition inasmuch as we believe that if we voted twenty million dollars' worth of bonds for a period of twenty years that the interest would equal the principal. We spend this seven million dollars each year, and we are getting a dollar's worth of work for every dollar we spend and it is about all we can handle and handle right.

MR. REED: Mr. Chairman, in the construction of permanent pavements we haven't yet found out what pavements

are permanent. In other words we have not yet discovered which is the best pavement. We are yet in the infancy of our knowledge on the pavement question. Therefore, is it advisable for us to go into a bond issue for the laying down of pavements which perhaps in five, perhaps in ten years, will not be adequate? In five or ten years we will have a better knowledge and can spend our money to better advantage. In our state of Washington I know we are developing our hard surface roads faster than the traffic will pay a revenue on. There is no question about that. If we have a bond issue it is true that if we do put down pavements we increase the valuation of our land sooner than the traffic on those pavements will return a revenue from in the amount you can haul in addition over those roads, but we don't get any additional taxes on that property by reason of putting down those pavements.

I venture to say that in all the states of the Union the situation is similar to ours when it comes to tax-paying time. Everybody says, "My God, look at the taxes. Let us cut them down." Now, with us, we realize that we have our hands full in expending the money we have to expend in pavements, and expending that money so that we get a dollar's return on the money expended. If we had twice or three times that amount to spend we would spend it more recklessly, we would invest it in sections that wouldn't warrant the investment and we wouldn't get as good results from our work. I am decidedly opposed to the bond issue.

MR. WILLIAMS: In answer to the gentleman who has just taken his seat, and for the benefit of those who have not had experience with bond issues, I will say that in West Virginia we have had a little experience with that problem. Four years ago the Parkersburg district of Wood county was paying fifteen cents on each hundred dollars to take care of its mud roads that extended out from the city of Parkersburg, outside of corporate limits, to the district boundary line. Eight months out of the twelve months in the year those roads were practically impassable. The district voted bonds enough to pave those roads with brick on a concrete base. The roads were paved and since the paving of the roads they are paying off the interest, taking care of the sinking fund and maintaining the roads with a levy of eight cents. If that is not a good investment (applause)—

MR. REED: Allow me to interrupt. There are conditions in districts where the natural soil makes the roads impassable for a certain part of the year, where you are warranted in doing that, but that does not commonly prevail.

MR. WILLIAMS: Mr. Chairman, it depends absolutely on the territory you are in. In a number of districts in our state where we have such conditions as I referred to, espe-

cially in the oil districts, bond issues have made it possible for us to quadruple the traffic upon the road and at the same time maintain the road with one-half of the tax levy that we used before.

There is a question that has not been brought up, that we have recently ran up against and taken care of. At our last session of the legislature we passed a law providing that before any community should issue bonds or attempt to issue bonds, it must have the service of a competent engineer to make a careful survey and take into consideration all of the questions pertaining to that road in that particular district, submit that, and that after being submitted to the county court,—or the board of supervisors in some sections,—it must be published; and then upon the petition of one hundred legal voters a bond issue must be ordered by the court. Then it requires a three-fifths vote to pass the bond issue. If it is passed, this money must be expended under the supervision of a competent engineer.

MR. KENYON: Mr. Lewis, who wrote this paper, is one of the ablest engineers, not only in the United States but in the world. He has given more time and attention in a big way to the subject that he is discussing than almost anyone, and we can hardly pass any statement in that great paper without being careful that we are not mistaken if we take the other side of it. There is one thought in there that I merely wanted to call attention to without discussing it at any length, and that was this. He called attention to what they are doing in England, that before a bond issue can be made they must have all the data presented to the road board and get its approval.

You know very well that now in most of our states in case a railway wants to borrow money and make a bond issue for extension or otherwise, it must first get the consent of the state railway commission. That is along the same line of the action in England in regard to the issuance of road bonds. I don't know whether it is practicable; whether the people would stand for that idea. Of course, they are perfectly willing to have the railroads regulated about the amount of bond issues that they shall have, but it is a question whether they would consent to have a highway commission, for example, or any commission, pass upon whether they should issue any bonds, or whether it was justifiable to issue bonds for building this road or that road, and the length of time and such other regulations as would seem to be necessary by that commission before granting permission to issue bonds. But it is a question that is well worth the consideration of everyone interested in the road question. The suggestion that was made by the gentleman from West Virginia that they must have an engineer and he must make an estimate and submit it to

him and so forth, is something along that line. It doesn't go quite as far. If they can do it in one state, and if it is wise and valuable with the railroads, is it not wise and valuable to have it done in regard to our state highways?

MR. EDDY: Mr. Chairman, may I offer a word or two more supplementary to what I said?

CHAIRMAN COGGESHALL: Certainly.

MR. EDDY: In the state of California, under the Savage Act, not only is a commission appointed, and the commission must prepare a report and show the roads that are to be improved and voted in a county, but they must employ a competent engineer who reports on these roads and two-thirds of the people must pass on the bond issue before it is issued. And the exact substance, the place where the roads are to run, must all be designated in the report of the commission. That is preliminary to the issue of bonds, and of course that simply supplements the state issue. It is one of the things that I wanted to bring up because Mr. Manthea is here and I think he can corroborate it. The maintenance in his county, where the best system of improvement in the United States is built, is better than it is in the republic of France, or the kingdom of England, or in Italy, because he is equipped with every modern device. He is equipped with a crew. He is equipped with considerable funds. He was here this forenoon and will be here again tomorrow. Now, the maintenance in that county is superior to any part of Europe that I know of and it is done at a cost that is not greater than that prevailing in European countries. Now, I think that that is a sufficient answer to many of the questions that have been raised. In England, of course, they improve the roads continuously by maintenance. They make paths along the roadways, even in the best roads.

JUDGE ALBERT: Mr. Chairman, may I say that the roads I spoke of are not gravel roads. They are permanent roads. No money raised in Oregon is expended on any other roads except on heavy grades in the mountains, but I am surprised at the confession of a certain gentleman from Washington, that the good roads won't pay dividends. I don't know of any other part of the United States where they won't pay, but I noticed from the report that they have got two hundred miles of road and seven million dollars a year tax. It goes for the maintenance of roads that are not good roads, as I know by experience. (Applause.)

MR. TERRACE: Mr. Chairman, I am not an engineer. I am only a common farmer and dairyman, and of all the branches of farming there is nobody that uses the road more than the dairyman, because he uses it every day, rain or shine. Conditions make no difference to him; that milk must be hauled to market. Therefore, he knows the benefits.

of good roads. But I raise other things besides milk. I raise cabbages. I raise potatoes. Now, let us see. I think the man from Washington is a little mistaken. I am from Washington also. I am the one that uses the roads and I am the one that knows whether it is paying or not. I am here to say that there is no part of my farm, neither my wagon, my mowing machine, nor anything in connection with my farm that pays a bigger dividend to me than the roads. (Applause.)

Now, let me illustrate. I can illustrate it to you in a very small compass. One year I raised seventy-five tons of cabbage. I had to haul that cabbage to a sauerkraut factory in South Seattle. As you know, the cabbage crop comes in the fall of the year, when the roads are bad, and we had no roads. Twenty-five hundred pounds was the best I could haul, using a team seventeen hundred pounds in weight, and if there are any farmers in the audience they will know that that is a good big team. Allowing five dollars a day for me and my team, which was little enough, I left my home at four o'clock in the morning, and I wobbled back home again at six at night, a tired man and a tired team. Now, allowing myself five dollars, it took five dollars to land that twenty-five hundred pounds of cabbage in the market.

Now what do I do? With a beautiful road, as fine as any street you have in the city of Seattle, brick, if you please, I put on five thousand pounds and I trot along that road, leave my home at eight o'clock in the morning and arrive back there at four in the evening without a turned hair on my team. It is a pleasure to drive over that road. (Applause.)

Now, you farmers, take your pocketbooks out and your pencils and you figure what difference it makes to me between it costing me five dollars to land that twenty-five hundred pounds of cabbage in market and landing five thousand pounds for the same price with a seventy-ton crop. Did it pay me? Was it good interest on the taxes that I have to pay? Why my taxes were only a mere bagatelle compared with it. (Applause.) Mr. Chairman, we didn't go into this thing with a rush, as I told you here yesterday morning. We have bonded that same county for three million dollars and we are spending today in that county nearly five million dollars. You can depend on it we knew just what we were doing. It is the best investment that any man can make.

MR. REED: Mr. Chairman, there is not any question but that a man can always haul from his farm over a good road much cheaper than he can over a poor one. When a railroad is built they determine what is the aggregate of traffic to pay interest on the investment. It is not what it

pays the farmer to ship his thousand or ten thousand bushels of wheat, but whether that road will haul a million or ten million bushels of wheat and pay interest on the investment. When a road is built in King county, costing twenty-five, thirty, thirty-five or forty thousand dollars a mile the question is what is the aggregate traffic over that mile of road? There is no question but what the one ton or ten tons can be hauled at a profit to that man that has that hauling. The question is, is there a sufficient number of tons to haul over that road to pay interest on so large a sum of money to build that road?

For example, when you build your roads it will pay to build your main arteries, but it won't pay to build your feeders at the same price per mile because the traffic over those feeders will not warrant the investment. That is a fundamental in highway engineering. Any man who has studied the problem, who has taken a course in the engineering department knows that. It is the return on the amount invested just as with any manufacturing plant.

MR. WILLIAMS: Mr. Chairman, I want to add just one word with reference to a point of instruction that we send out from our highway department. The engineer that considers the highway bonds considers the probable tonnage that the road will have to take care of, and likewise provides an estimated cost for that road to take care of that tonnage. The engineer would not be a competent engineer that would provide the same class of construction for fifty thousand tons that he would for two thousand tons. That is a principle of engineering and one of the things that the highway engineer should consider, but the man that has two tousand tons should have a road to accommodate that two thousand tons, just as well as the other man that has the fifty thousand tons.

MR. EDDY: Have you considered the question of a highway census?

MR. WILLIAMS: The question of a highway census is not a finally determining factor because the improvement of roads sometimes will treble, quadruple and sometimes make the traffic even ten times as much as it was prior to that time.

MR. EDDY: But as comparing two roads radiating from a common center. Supposing one has doubled or trebled its traffic and the other has not. Doesn't that give you a basis to work on?

MR. WILLIAMS: Yes, in a way, and no in a way, because the greatest determining factor that must be taken into consideration when you are going to improve a road, is the territory back and along that road, and what the territory

will produce in the way of tonnage. Let it be the tonnage of farm products, for instance, and you certainly would not consider the tonnage coming out of a rough country with no farm land along the road the same as you would where you had a good broad valley and hundreds of acres of good productive land.

MR. EDDY: I am speaking of agricultural land entirely. Mr. Chairman, I just want to call your attention to the fact that in almost every county in California that is bonded for this purpose, a road census has been taken of every road that is proposed for improvement, and they have been able to submit to the taxpayers the amount of traffic on every road. That is one thing I think that has been insisted on and I know it is insisted on by the road maintenance engineer of San Joaquin county.

MR. MEATH: Mr. Chairman, you will notice that we fellows up in Washington are a little bit divided, but we always get together and are building roads. Now, if the gentleman was to come up to Washington I would like to show him some of the best roads in the United States right in the state of Washington. You can take your automobile, if you please, at Seattle and get on a continuous pavement to the city of Tacoma, forty-two miles, passing through one of the most fertile valleys of the United States. Then, from Tacoma, you can go on an additional fourteen miles of pavement and then you will strike high-class earth roads, and in five hours from the time you leave Seattle you can be up at Mount Rainier, one of the most beautiful mountains in the world. Now we have good roads there. We scrap a little bit about this bond issue; we have a different method; but we are like the Baptist or Methodist, we are all headed for the same place.

JUDGE ALBERT: I have driven over those roads and I have wondered how the gentleman could make the statement that they didn't pay revenue.

MR. WHITNEY: There is one phase of this question we have not considered. You have principally made your argument along the lines of saving in freight. Now there is another feature that is very important, it seems to me, that follows along the line of modern road construction, and that is the saving in the wear and tear and the upkeep of the motor vehicles as well as your horses and wagons. In Sonoma county, north of the bay, where I live, they attempted a few years ago to carry a bond issue of sixteen hundred thousand dollars. During our investigation we took into consideration, as they did over in San Joaquin county, every feature that would follow the building and improvement of those good roads. One of those features was the saving in the upkeep of the automobile.

We have in Sonoma county in the neighborhood of two million dollars invested in automobiles. Our engineer made a conservative estimate in the difference of cost of upkeep of those important machines, and we also had the assistance of other engineers in the state. One gentleman from Pasadena, a very competent man, gave an estimate that the difference in the upkeep of automobiles under the improved systems of highways in Sonoma county, which we estimated would carry about seventy per cent. of the traffic of that county, would be conservatively two hundred thousand dollars a year. That is a point that is well worthy of consideration. Now we gave this engineer from Pasadena a rough estimate of the number of teams, vehicles, horses and wagons in the county, and he gave us an estimate of something over one hundred thousand dollars in the saving on those vehicles and horses. Now, our bond issue was for one million six hundred thousand dollars, bearing five per cent. You can readily figure what our principal and interest would be on an average during a term of twenty or thirty years, and we figured it a pretty good investment—three hundred thousand dollars saved on that class of transportation alone. (Applause).

MR. COBB: Mr. Chairman, I think that we should all feel proud of Washington if they are able to pay for the roads as they go along. I think that every community would be glad to do the same thing, and it is certainly a very fortunate community that can build roads that are justified by present-day conditions without issuing bonds. I would like to know if every county in the state of Washington is able to do that. I wish to offer this prediction that in a very few years the state of Washington will either stop building roads or issue bonds for the reason, as one of the gentlemen stated there, that they have taxes up there just about like they do in other states. They are expending large sums of money on a short mileage of road and the result is going to be that the people who are not getting any benefits of the roads are going to oppose this expenditure. So to cover your entire territory and build roads for all of them or to build roads for a sufficient number of them to secure a sentiment in favor of raising money they will be ultimately compelled to issue bonds. I don't see how it can possibly be done otherwise. As I say, I believe that all of us are glad to know that Washington is now paying as it goes.

MR. MAC KENZIE: Mr. Chairman, I would just like to give a word of information, but before doing so I have a telegram that I just received that I would like to read to the convention. It is from the main steering wheel of the road machine in our state, our governor. He sends me this telegram:

"C. L. MacKenzie, President Washington Good Roads Association, care Pan-American Road Congress, Municipal Auditorium, Oakland, California.

Kindly express to the members of the road congress my sincere regret at not being able to be present. I consider road construction one of the most important elements in the development of a state. I am sure much good will come from the deliberations of the congress.

(Signed) Ernest Lister,
Governor of Washington."

(Applause.)

I want to say in relation to our system of building roads in Washington that I believe it is not clear to some of the gentlemen who have been participating in the discussion in relation to bonds. Our roads in Washington are built under the provisions of two laws. One is the State Highway Law, and that levies one mill against the general property of the state and goes into a fund that is disbursed entirely by the highway commission. Those roads selected by the state legislature are improved with this money absolutely under the supervision of the state highway commission. The other law provides for a mill and a half levy and has carried that levy now for four years, and it is called a permanent highway law. That law provides only for the building of hard surface roads. Those roads must begin at a trade center and the improvements must connect with the part already improved. The improvement under the permanent highway law originates by petition from seventy-five per cent. of the property owners adjoining the route petitioned for. The petition is accepted by the county commissioners, and approved by the state highway commission. The county commissioners contract for work, and the completed work is approved by the state highway engineers before final payment. Property within a three-mile radius of that route carries fifteen per cent. of the cost of that improvement, payable in installments. It eliminates entirely the question of selecting what road shall be improved, the theory being that if these men are willing to pay part of the cost of the improvement then it is up to the collective users of the road of the county and the state to put up the balance of the money. That money is paid in to the state, but is credited to the county which pays the tax. Our county has a valuation of about forty-four million dollars and pays into the permanent highway fund seventy thousand dollars a year, approximately. We have built under the provisions of that law in my county about thirty or forty miles in the last four years. We have at the present time petitions from property owners, mostly farmers, for about thirty miles more, enought to take up the revenue for three or four years. They are petitioning that far ahead for improvements. The state highway funds are being expended

to complete an agreed-to system of highways that cover the state, agreed upon by our legislature and highway commission. We have the Pacific highway, which extends from the northern boundary of the state to Portland, Oregon, as one highway. We have several other highways. We have the Inland Empire highway, which crosses the state completely from east to west. The Inland Empire highway is about eighty per cent. completed at the present time. The Pacific coast highway is the north and south road and perhaps about eighty per cent. is completed at the present time.

Under the classification of improved earth roads we have in our state at the present time four thousand five hundred miles. Now that doesn't mean just a plain, common, ordinary country earth road. That means a road properly located. In our state we hold to this theory that the only permanent part of the highway, no matter if you build it out of iron, is the location and grade, and that part of our system we have endeavored to make permanent. We have spared no expense in getting the best grade to be had. Five per cent. is the maximum grade that will be approved on any permanent highway or any state highway by our highway commission. We then build these roads. The earth grading is done; the culverts are put in; the drainage is provided for absolutely on the best engineering advice obtainable. Concrete is used almost entirely in these roads at the present time. All culverts, all drainage pipes are concrete, but the work done by the state up to the present time practically is simply the earth grading and has cost us in the neighborhood of two thousand dollars to three thousand dollars a mile. We plan to do the hard surfacing later. There are two reasons for operating under that plan. We are operating under that plan in our county at the present time, under our permanent highway law as well, which law does not contemplate doing first an earth grading and then doing afterwards a hard surface. We could, if we desired, build a road in its complete state the first year, but we desire or think it best, and find good results to come from building the earth grade first. We let that settle the first year and then provide for the hard surface afterwards. That is the plan that the state is following in the construction of state highways for two reasons. We desire to have an absolutely perfect sub-grade, one that will carry the hard surface afterwards, and it should have a year to settle. Most of the defects in hard surfaces develop from a deficient sub-grade or deficient drainage. Second, the best medicine for an anti-good roads man, and we know, as we used to have them, and they used to be in the majority in our state, is to give him a taste of the road that has proper grades first. We have had these good roads, and in order

to get the grade we wanted have had to put them through with intense opposition; but after two or three months' use by the farmers and the others who use them and who, perhaps, led the opposition they have reformed and became enthusiastic boosters for good roads. The second year we usually have no opposition whatever to hard surfacing that dirt road. The dirt road can be kept and we do keep them in the best possible condition. We use road drags freely, and for six or eight months in the year the road is good. I will say here that if a dirt road is kept in condition there is no better road as long as it is dry, but wet weather comes on and you can't travel a dirt road. Then your man, who perhaps is not an enthusiast for building a fifteen thousand dollar a mile road, but who has tolerated a two thousand dollar a mile road, immediately becomes a convert to the fifteen thousand dollar kind because he wants to use it in the winter time, and he urges the hard surfacing of the dirt highway. As to the figures for road mileage in our state referred to by my friend, Judge Albert, I would say that we have at the present time forty-five hundred miles of improved earth road, laid out under the five per cent maximum grade provision with absolutely the best drainage provided, ready for hard surface which will come later on. We have thirty-seven hundred miles of gravel road. Now, these are gravel roads, not graveled in a hit and miss manner, but graveled under the supervision of our state highway commission. Then we have paved roads five hundred and fifty miles.

The solution of our difficulty and the establishment of an absolutely sound footing for the good road sentiment in our state was the passage of the two laws just mentioned, and the establishing under their provision of a highway commission which provides for a highway commissioner and an engineering force which is recognized by all our counties and county officials as the recognized central authority in our state on road construction or road promotion. And, gentlemen, I think that many and many of the problems referred to here in the way of opposition would disappear if you could promote and establish within your states such a system as we have providing for the building of good roads.

SIDNEY SUGGS (Oklahoma): What width have you given those roads?

MR. MACKENZIE: The term road refers to twenty-four foot width. We aim to hard surface the road fourteen to sixteen feet wide.

MR. SUGGS: That is a question that has been discussed a good deal, the question of width of road. In a great many of our counties they have been building the roads too wide,

putting too much money on the sides of the road and not enough on the road.

CHAIRMAN COGGESHALL: The hour is getting late and there are yet two papers to be presented. I would ask the gentlemen to confine themselves closely to the subject under discussion. The paper under discussion is "Highway Indebtedness, Its Limitation and Regulation." If the gentlemen will confine themselves to that paper then we can take up other matters under other headings.

MR. COBB: I just want to ask one question. I would like to know what is your constitutional prohibition against amendment? Does your constitution in the first place prohibit your issuing bonds? Do you have to have a constitutional convention to correct what we might call a defect in the constitution?

MR. MACKENZIE: We had to have before we could issue bonds. We had to provide a method of issuing bonds. Our constitutional provision prohibits the issuing of bonds, or at least we now have a statutory provision for issuing road bonds.

MR. COBB: You can issue road bonds by a vote of the people?

MR. MACKENZIE: We have only four counties in the state who have issued bonds.

MR. COBB: Can the state issue bonds?

MR. MACKENZIE: The state cannot for road purposes, is my understanding of the constitution.

MR. COBB: Well, I think you certainly have very good road boosters in your state if in view of the fact you can't issue bonds you can raise such large sums of money. As I said before, I doubt if you are going to keep it up any great length of time.

MR. ROY: Mr. Cobb brings up a question there that I don't know whether our men have made plain. We think that is one of the best things in our state road law; that is, in the first place, that we have a system of state roads which is authorized by the state legislature. We have the Sunset highway from the east, coming out of Idaho, and going through the state from east to west, crossing the Cascade mountains. We have the Pacific highway, from Blaine at the Canadian border, coming down south through Seattle, Tacoma, the city of Olympia and on to Portland. Then we have a number of less important state roads or primary roads, and then we have a number of secondary roads, but these are all put on the map by the state legislature. Now we have our permanent highway laws. Mr. MacKenzie referred to them and they provide for the surfacing of these roads and the application of this permanent highway money on these roads is provided for under the

law and the plans have to be approved by the highway commissioner. The law provides that in starting the improvement, or the surfacing of a road, which most generally is one of these state roads leading out of the trade centers or county seats, it must continue out towards the next trade center. This harmonizes the interests in all these roads in the rural districts and eliminates contention. Each neighborhood road can't be improved, but the main arteries are improved in the construction first by the state and then by the application of the permanent highway money. No money can be used except by contract and no contract can be for a less distance than one mile, so that they have to have money to lay a mile of road and let it to the lowest bidder under straight competition and under strict supervision. So that our people are getting the roads built out from one trade center towards the next. All these have feeders on earth roads, and a great many of them are graveled by the agricultural communities, thus eliminating practically all the contention and little bickerings as to who shall have a road this year and who shall have it next year. We are getting away from that and getting harmonious action from our people throughout the state on account of the satisfactory working of our two highway laws.

MR. CARLTON: I would like to make one statement in regard to this matter. The rate as given by the gentleman from Washington if applied to the state of California would produce seven and one-half million dollars in one year. Now, I don't think it will be long before Washington will get tired of that rate. In California we think it is a great thing to spend eighteen million dollars by a bond issue. We think we are some road builders.

MR. WILLARD: I want to say one word in regard to the value of road building. I have heard this discussed a great many times. It is a question that has to be settled in men's minds, because even in such an intelligent audience as this it is being discussed. In our counties it seems to be very hard to get it into men's minds, but it seems to me singular that it should crop up in such an audience as this. What is a dollar worth anyway? I ask you, gentlemen. Is it worth five cents, or six cents? That is the ordinary rate of interest. Is it worth any more or any less, from whichever source it comes?

Now, gentlemen, assume if you take a direct tax and put it in road building that the state is getting the money practically for nothing. Is that the end of it? Every dollar put into the road continues to earn or to be worth at least that interest for every year for all time to come, and the only kind of money that you ever could get for nothing would be the kind of money that people might have in their

boot-leg or in the toe of an old sock that wasn't doing anything. As a matter of fact, does Washington have that kind of money? Mr. Albert said it was in the pockets of the people and that the state had no money itself. Now then, whether you take that money and put it out under a bond issue and have a systematic scheme of road building or whether you get it by direct tax and build a few miles this year and a few miles next year and eventually get those two roads together, the cost is just the same. It is worth five per cent for every year. But do you have a system there which permits you to get at one time what you need or what the country believes it needs in the way of road building? The only possible logic in not doing it that way is the one suggested by this gentleman, namely, that if we believe we are not sure as to the kind of road we ought to have that would be a legitimate reason, we will say, for not doing it in a systematic way. If that is the case, then this levy of two and one-half mills in Washington ought not to be made but fiddle along for about two years until you are sure and the type of road you want is determined upon. (Applause.)

MR. REED: That is right and wrong, consistent with the point of extremes.

MR. TERRACE: Mr. Chairman, I don't like to get up so often, but I don't like to see Washington put in a bad light. I want to say that we are not fiddling along. Washington is divided into two equal parts. There is eastern Washington and there is western Washington. There is as much difference in those two sides of the state as there is between night and day. One is a dry area and the other is a wet country where they haul their wheat out over the snow. They use the dirt roads, and they put straw on them when they get impassable in the summer. Western Washington is heavily timbered; great forests; no bottoms to their roads, and we must do something else. We have paid our mill taxes and our mill and a half in the state treasury, and we haven't been satisfied with that in western Washington. We have bonded ourselves in the county I live in for three million dollars, if you please. We are spending pretty nearly five million dollars and we are not fiddling along. I mean to say that the state of Washington is one of the most progressive states in this whole Union. (Applause.) That has been our great fight in Washington for years, and your humble servant has been in the front ranks from the very commencement, between eastern Washington and western Washington. When we spoke about our high priced roads they kicked and bucked about having to pay state taxes to build those roads. Well, we said, we will pay our share of the taxes into the state and we will

bond ourselves and we will not ask you fellows for one cent, but we are going to have good roads. (Applause.)

MR. MEEKER: Mr. Chairman, it is an axiom that you can take any community of farmers or otherwise and if they have pretty good credit they will be a little more lavish in what they buy and careless as to whether they get their money's worth. Now we pioneers built our roads without bonding and pretty nearly without taxation. We took our shovels, and our axes, and our teams and we went out and we built the road, wide, too, at that time, but it brought a spirit among the pioneers that they should build the roads and pay for them as they go along. If you run into debt indiscriminately with your bond issue you are not likely to get your money's worth like you will if you are taxed and pay for it as you go along. Admitted that you can forge ahead faster with bond issues, you must remember the generation to come has some rights which we must respect. I believe in paying as you go.

JESSE D. JEWKES: I believe at this juncture it is well to say that consistency is a jewel. There are extremes and there are the means. I want to speak just a moment or two as to our system of raising funds in Utah. I am proud to say at the outset that we believe in unity and that the strong shall have a regard for the weak. The fund that is raised in Utah is $1,800,000 a year. We are a small state, not so wealthy, but we believe in doing our utmost for roads. First of all, we have the road spirit. We want roads and we want to get them the best way possible. We do not feel at this time that it is wise to bond.

There are a great many factors that enter into this question, it seems to me. First, in respect to the remarks of the gentleman who made the suggestion here this afternoon, have we fully determined what type of road will best endure in our state? Perhaps a type of road that you are building in California would not endure the climatic conditions in Utah, and I believe there are conditions to figure on and talk about. But getting back to the question of funds, we did bond in the state of Utah, made a small bond issue some three years ago for two hundred and sixty thousand dollars, a very small bond, but that bond issue was the means of developing the road spirit in our state. We divided the proceeds received from that bond issue equally among the twenty-six counties of our state, one being omitted. That was the most wealthy one. Salt Lake county, our most populous and most wealthy county, waived its right to the weaker counties and did not participate in any part of this bond issue. Many people have seen fit to complain even about this bond issue; and in various gatherings in talking about this question I put out the question to a number of

our citizens, some of those who have had reason or felt that they had reason to complain. Gentlemen, what is this really costing you?

Those that were opposed to the bond issue I asked this question: What do you really think it costs the man who pays tax on an assessed valuation of a thousand dollars to pay back this bonded indebtedness? I have been very surprised at the answers received. Without taking too much time I want to tell you that it costs the man in our state in tax on a thousand dollars one cent more than a shoe shine each year to pay back the principal and the interest. That bond issue did do something. It brought about the road spirit. The bond issue was divided among the twenty-six counties and we built some good roads with it of an earth type. Today we have a tax. We have the right to tax the counties, as the county is the unit. We have had precinct units in the past that could levy a tax not to exceed five mills. Today we have a county unit in levying taxes, and the proceeds received from this tax are used in connection with the appropriation made by the state. We are building today the roads as we go. There are sections, however, in our state that I believe could be bonded, and it would be well to do it because the type of road that is constructed would be permanent and should be. In those sections I think it is well to bond.

Now let it be an economic question. Are we building economically? Is every dollar doing its full value? We feel that in our state it has been, as much as it is possible for public money to do. I have listened with interest to the discussions here this afternoon, and I would say in concluding that the wise thing to do is to find out the condition. If the condition warrants the bond issue let us have a bond issue. If we are not yet prepared for it, if our population is sparse and we haven't the valuation consistent with bonding and expending money for a type of road that will endure, then I think we should be willing to pay as we go. (Applause.)

MR. FARLEY: I want to supplement the remarks of the gentleman who said that a dollar was worth five cents or six cents whether you were a borrower or a lender. I quite agree with that principle. I think that is quite the obvious principle. I also want to say this; that with a bond issue as compared with a direct tax system the people who use the roads are those who pay for them under the bond issue. There is no question that the science of road building has reached a point where we can build a road which will last twenty-five years or twenty years, or the term of a reasonable bond. In that case those people who use the roads for twenty or twenty-five years participate in the payment for

them, which is just and equitable and which is sound finance. It is a very generous thing for the state of Washington to build permanent roads which will last twenty or twenty-five years and give them to posterity. That is a fine, courageous spirit, but among many of our communities it would cramp the legitimate development of other public functions, of other public necessities, and that would be wrong. There is justice in a bond issue as compared with a direct tax for the purpose of building permanent roads. In every sense it is an equitable proceeding. As regards the cost I think it should be particularly emphasized that we do not pay two and one-half times the value of the bond issue in paying it off or any number of times the value of the bond issue. The money is worth five per cent. whether you are a borrower or a lender. The seven million dollars which the state of Washington raises in a year, or whatever amount it is, is worth five per cent. to those people who paid it. Now they are paying in one year for something the people will use for twenty years. Posterity has its claims on us, but it is not a claim that might endanger the legitimate development of other public necessities. (Applause.)

MR. BUTLER (Los Angeles): I am neither a good road engineer nor a good road builder. My work follows the completion of good roads. I handle the traffic department of the city of Los Angeles. I am a good road booster. That is why I am here. I am taking my vacation. I am here to listen to the discussions that are taking place in this convention. Los Angeles is a pioneer county in southern California in the road building and bond issuing in that part of the state. About six or seven years ago—as I say I am not in the road building business and I will have to deal in general instead of specific figures—about seven years ago the county voted something over three million dollars to build roads. They built with that three million dollars about three hundred and ten miles of macadam, hard-surface road; and at the present time, within the next sixty days, there will probably be a vote taken on the question of issuing three million dollars worth of bonds for additional good roads. I believe the opinion in Los Angeles county is unanimous that the roads are the best investment that the city or county own. The roads extending into the country extend to the county lines, and since we began the construction of these roads every county adjoining Los Angeles has voted bonds ranging from two and one-half to three million dollars, and are all at the present time—I believe Ventura county just voted bonds about a month ago—are now actively engaged in the work, if not in actual road construction, in the work preliminary thereto; and I have had occasion to notice the traffic reaching the city over those lines.

My acquaintance is large throughout the rural district. I happen to know one man thirty-two miles away from the city engaged in the dairy business. Previous to the completion of the roads it was necessary to haul his milk a couple of miles to a station and depend on an electric car to pick it up, take it to the freight yards, have it picked up at the freight yards and taken to the distributing station in the city. Since the advent of this good road a man has gone into business with a truck and he goes around to the small farmers, the small dairymen, and in two hours from the time the milk leaves the farmers' doors it is in the distribution station at Los Angeles.

The Harbor boulevard reaches from the harbor to the city, about sixteen or seventeen miles. Previous to the advent or previous to the completion of the harbor boulevard the freight that came in by ship was unloaded in the warehouses and from there into a freight car and from the freight car into the shed at the wholesale house in Los Angeles, and from there to the retailer or jobber. At the present time tractors are operating on that boulevard. I think one firm in the city there used heavy two-horse trucks. They were in the trucking business there for several years, and now they have purchased a tractor. They hook eight or nine or ten two-horse trucks onto that tractor and bring a trainload of that freight up that boulevard every hour directly from the dock and distribute it either to the wholesale houses or to the retailers if they have an order of that magnitude. Some do not stop at Los Angeles. Instead of stopping in Los Angeles they take those roads clear on through to Pomona and as far as San Bernardino without even unloading in Los Angeles. They save handling by the men. Does it pay those people to pay taxes to get good roads? It is a saving in the handling of goods and a saving in expense to the consumer.

In that connection I think it would be well for the engineers who are building these highways to look into the future as to the weight of loads to be hauled on these boulevards. Our boulevards were considered at the time, five or six years ago, when they were built, heavy enough to carry these loads. Since that time heavy tractors have been built and are hauling enormous loads. The question is can you build a road now that will withstand the load that will come hereafter? With the development of the motor truck we will be hauling heavier loads, and that is one thing that we find on the roads in Los Angeles that has been to the detriment of the roads. The roads were not heavy enough.

CHAIRMAN COGGESHALL: Pardon me. The subject under discussion you know is "Highway Indebtedness, Its Limitation and Regulation."

MR. BUTLER: In conclusion I would like to say that from the standpoint of the investment—what I was getting at was the standpoint of investment—is that those highways have more than returned the interest necessary to pay those bonds in taxes derived from added wealth to the county, in development of heretofore undeveloped country. And if Los Angeles were asked today to determine whether the investment is a good one or not there would be an unanimous verdict that it is. (Applause.)

CHAIRMAN COGGESHALL: Is there any further discussion on this subject? I have been asked to give two or three notices and call your attention to the excursions. You will find them in the program of the Pan-American Roads Congress. I would say for your further enlightenment that the excursions will start on Saturday morning from in front of Hotel Oakland. I have been asked to tell you that it is well worth the money for you to go because it won't cost you a cent. Everybody wants to come and go on the excursion as the guests of the promoters at nine o'clock on Saturday morning from the Hotel Oakland.

I have here a letter to the convention from the U. S. Products Company:

"San Francisco, California, September 14, 1915.

To the Officers and Members of The Pan-American Road Congress, Auditorium, Oakland, California.

Gentlemen: We desire to extend to the officers and members of the Pan-American Road Congress in convention at Oakland, an invitation to visit the exhibit of the United States Steel Corporation and subsidiary companies in the Palace of Mines and Metallurgy. We have an exhibit covering all our department products and uses thereof, together with a motion picture display showing all of the corporation's activities, together with a Music Recital Hall. Our representatives and attendants will be most pleased to receive your members and extend to them any possible courtesies.

Trusting that we may have the pleasure of a visit we are,

Yours truly,

United States Steel Products Co.,

Pacific Coast Department,

(Signed) A. T. DeForrest, Vice President."

We are in the receipt of a telegram from Judge W. S. Worden, treasurer of the Tri-State Good Roads Association. Judge Worden was to preside at one of the sessions tomorrow, I think it is the afternoon session at the exposition. He wires:

"Expected to be with you today, but circumstances beyond my control prevent my coming. Please express my regrets to the Pan-American Road Congress.

(Signed) William S. Worden."

I would say that from a personal acquaintance with Judge Worden I feel that it is your loss that he will not be here to preside tomorrow, as you would find him to be a most excellent presiding officer.

The Pacific coast association, the Tri-State Good Roads Association, has been honored again today by being asked to furnish another of its members to preside over the convention with myself at this meeting. Therefore it is my pleasure to introduce to you the Hon. J. H. Albert, of Salem, Oregon, one of the directors of the Tri-State Good Roads Association, who will preside here for the balance of the session. Gentlemen, Hon. J. H. Albert. (Applause.)

(Hon. J. H. Albert then took the Chair.)

CHAIRMAN ALBERT: The next item upon the program is "Organization and System in Highway Work." We have a paper by A. B. Fletcher, state highway engineer of California. Mr. Fletcher is not present, but his paper will be read by Mr. Sharples.

MR. SHARPLES: Mr. Fletcher wished me to express his regrets in not being able to be present with you this afternoon, owing to urgent state business requiring his presence elsewhere.

Organization and System in Highway Work

By AUSTIN B. FLETCHER

Highway Engineer, California Highway Commission

(Read by Mr. Sharples)

It goes without saying that no highway department—municipal, county, state or national—can exist successfully without organization and system; but it is equally obvious that no general system can be set up which will be workable in all such jurisdictions, or, in fact, which will be generally applicable to all departments of the same sort of jurisdiction. The laws and customs differ so greatly in different localities that for that reason alone it is not possible.

The prime essential in any highway department is a force of loyal, able servants of the public who are willing and ready to submerge self-interest and to perform real, conscientious service for the public. No corporation, public or private, can long exist if the attainment of personal credit is the chief aim of its officers and employees.

The essential next in importance, in my opinion, is a rigid establishment of responsibility for the various acts of the department.

It is true that a small highway department can often be managed fairly successfully without many rules and with little formality or system, depending much upon the personal characteristics of the head of the department; but in the case of the great state departments charged with the responsibility of expending wisely large sums of the money of the people such an easy-going plan is unthinkable.

In the large highway departments every official and employee, from the top down, should have his duties and responsibilities fixed as closely as it is possible to fix them,

and it is one of the principal duties of the executive officer to see that each employee under him stays in his own corral.

I would not like to be understood as meaning that there is not room for friendships and consultations among the employees and between the employees and the head of the department, for I believe that anything which will promote good fellowship or, if you will, "esprit du corps" in the department should be encouraged. All machinery, human or otherwise, requires a proper amount of lubrication to make it effective; but if the several parts of a machine are not properly designed, adjusted and made of the right sort of stuff no amount of oil will prevent friction.

In most of the state highway departments of which I have knowledge the head consists of three commissioners, usually appointed by the Governor of the state. If the department has merely to carry on the orders of the Legislature, supposing that that body has defined the roads which are to be built and left no choice as to their locations, I can see no necessity for more than one commissioner. Usually, however, the Legislature does not fix the routes with any degree of accuracy and the department must make selections. The selection of routes is not an easy task, since the people have many ideas as to where the roads should be placed and many ingenious arguments to present in support of their desires. In such an event three commissioners are none too many. But if the department has only to build and maintain roads, a single-headed department can doubtless work faster and more efficiently, to use that much overworked word.

The tendency of the times is toward placing all public employees under civil service. This has developed some awkward features and I have no doubt that the public has sometimes paid more for its highway work because of civil service than without it. There are unavoidable delays in securing employees which are doubtless reflected in the cost of the work, and employees have probably been retained, because of civil service rules, who would have been discharged under other conditions.

I believe, however, after an experience of many years, that the personnel of a department under civil service control will average much greater in efficiency than under the older plan of appointment and retention because of political influence; and I have noticed no lack of "esprit du corps" traceable to the civil service idea. The new plan now proposed in California of retaining employees, when the forces must be reduced in number, on the basis of ability and with little regard for seniority will correct one of the difficulties.

When a new highway department is about to be organized, a business system must be developed to carry on the work effectively. Many engineers and commissioners are able to

set up such a system, but in these days of experts in all lines of human endeavor it is much easier and usually better to call in a "business systematizer" to work out the problems, at least in a consulting capacity. A good man of this sort can save the department much labor and time.

The accounting systems of the states vary greatly. Most of them are archaic and often much skill is required to adapt them to the methods of modern business. Public work differs greatly from private corporation work in this particular. Aside from the various and many safeguards which must be placed about the spending of public money, and which are usually statutory prohibitions, there are many requirements which may be truly called "red tape methods" which should be done away with.

Some of the "red tape" is merely tradition in the auditing boards. The business systematizer will help to cut this.

Other things being equal, the simpler the system which is devised, the better. I have a suspicion that, left unrestrained, the systematizer's natural bent is to evolve a complicated assortment of records, hard to understand when made up and of little practical use. Each record and account should tell its story in the simplest manner and at the least possible cost of labor.

It is hardly possible for a highway department to do all of its work by the contract plan. Small pieces of work or work of a complicated nature may often be done best by the day labor method.

It is almost impossible to do work by day labor unless the department has at its command ready money in the form of a "revolving fund" or "working capital." Unsatisfactory employees have to be paid off before they are discharged and the laborers in general should be paid weekly or at the most every two weeks to keep them contented.

If the department supplies materials to its contractors or for its day labor work, it often happens that freight charges must be advanced. In order to purchase its supplies at the most advantageous rates it is often necessary to make payments faster than the usual auditing routine will permit.

The establishment of a "revolving fund" or the setting aside of a sum of money from an appropriation to the credit of the department to be checked out by it without audit until after the expenditure has many advantages; but, of course, there is also considerable risk involved. I know of no way of avoiding this risk except by using extreme care in the selection of the persons handling the funds and by requiring all such persons to furnish fidelity bonds in an adequate amount.

In California the people voted to expend $18,000,000 in building a system of state highways. The roads were desired quickly and there was no limit placed on the amount to

be expended in any one year. The act of the Legislature and the referendum act relating to the bond issue did not locate the roads except in a most general way.

The department of engineering of the state was intrusted with the expenditure of the money and the department was augmented by three members called in the law "appointed members," it being the intent that the additional members should devote their attention to the state highway work. A highway engineer was also added to the department and provision was made for such engineering and other assistants as should be needed.

The department of engineering by resolution delegated to the "appointed members" thereafter called the California Highway Commission all of its authority concerning the state highways which it could confer upon it legally.

Not long after studying the problem the commission concluded that, considering the magnitude of the project, it would be best to organize upon a basis as nearly like that of a large private corporation as possible. It set up departments of engineering, accounting and purchasing and made the secretary the disbursing officer. The highway engineer was made the executive officer of the commission and the several departments report to him directly.

An able firm of business systematizers was retained to assist in devising a scheme of accounts and forms and their work was done so skilfully that but slight changes have been needed during the three or more years of operating under it.

It was determined early that it would be best to purchase the materials for construction and deliver them to the contractors, thus by purchasing in bulk controlling the quality of the materials and securing them at prices lower than the contractors could.

The Engineering Department of the commission now has reporting to the Highway Engineer three Assistant Highway Engineers and seven Division Engineers, each of these officers having certain definite duties to perform. The First Assistant Highway Engineer acts as deputy to the Highway Engineer and under his direction has charge of all of the activities of the department. The Second Assistant is expected to spend all of his time on the construction work in the field. He reports directly to the Highway Engineer and gives no orders himself to the division engineers whose work he inspects, although he often consults with them. The Third Assistant is stationed at headquarters and works under the direction of the First Assistant. The headquarters office engineering force is small and does principally reviewing of the work of the division offices. It also prepares the specifications and a considerable amount of bridge designing and checking.

The state was divided into seven divisions after much study of the topography, density of population and other factors, and each division was placed under the direct charge of a "Division Engineer." Each Division Engineer has entire control of the work of his division, including the surveys and plans, the construction work and the road maintenance, and it will be observed that the division engineers are very important spokes in the organization wheel.

I am not aware of any special innovations in the foregoing plan of organization unless it be in the case of the "Second Assistant Highway Engineer." Under some conditions such a position might be extremely difficult for any man, but "personality" in the officer himself and the loyalty and breadth of the division engineers have made his task both effective and agreeable.

The purchase and delivery of materials is also somewhat new in state highway work. It entails much labor and expense which under other conditions are absorbed by the contractors.

But the plan is surely worth while. The old worries about the quality of materials are done away with as are also many of the delays in delivery. The struggle, usually successful, of the Purchasing and Engineering Departments to keep the contractors amply supplied with materials, adds a zest to the work.

California, if she has not already the feeling, is going to be very proud of her system of state highways.

No small part of that attainment will be due to the loyal, conscientious work of the several hundred servants of the people composing the organization.

I, myself, am proud to be one of the spokes in the wheel.

CHAIRMAN ALBERT: This paper was to be discussed by H. R. Carter, state highway engineer of Arkansas, and by Mr. C. D. Blaney, chairman of the state highway commission of California. Are these gentlemen present? Apparently not, so that the discussion of this paper is in the hands of the assembly. Is there anyone present who wishes to participate in the discussion, either to call attention to or criticise any portion of the paper? If not, we will pass to the next item, "The Educational Field for Highway Departments." We have a paper by Prof. L. S. Smith, Department of Highway Engineering of the University of Wisconsin. Mr. Smith is not present, but his paper is here and will be read by title.

The Educational Field for State Highway Departments

By PROF. L. S. SMITH
Department of Highway Engineering, University of Wisconsin

The writer realizes that there are many state officials present far more competent to present this important phase of

highway work than he. All that he will here attempt will be to give some suggestions which have been gleaned from a careful study of road and pavement conditions at home and in European countries. The limits set for this paper will scarcely allow of more than a general introduction of the topic. It is of course expected that state highway officials and others will add such valuable discussions as their own experience may suggest. Because of the fact that the road problem in each state is now and always must be to a great extent a local question, close agreement of detailed ways and means cannot be expected or even desired. It is to be expected, therefore, that the educational field of state highway departments will vary greatly in different states, due to the widely different conditions of population, traffic, road materials, etc. And yet the writer believes we can all agree upon three all-important truths as constituting in one form or other the main educational field in every state. We must teach our people by road literature, by practical object lesson construction, and in our technical schools that a successful state highway system is absolutely dependent upon: First, a *scientific selection* and design of the proper type of construction for each widely different section and service; second, *scientific construction* of the entire road in its many details from foundation to wearing surface, and, third, *scientific maintenance* of these roads to secure a minimum total annual cost to taxpayers with a maximum of comfortable service.

The writer is well aware of the fact that the great mass of our people are far from being convinced of the above statements. This fact, indeed, furnishes the pressing need for an educational propaganda. Our almost countless numbers of non-expert and short-term local highway officials (4,000 in Wisconsin) have attempted for 50 years to construct roads. Their efforts have consumed many hundred millions of dollars, but up to the time, in very recent years, when state highway departments took responsible charge of this work, the net results of their enormous expenditures were road conditions little, if any, better than when these officials began their objectless and endless tasks.

This fact has been so long before our people that it seems strange its vital import has not sooner and more generally been grasped. It will be noted that state highway departments have received financial support in our various states in direct proportion to the public recognition of the futility of continuing the old, discredited system.

Except in a few states, this financial recognition by the public has been grossly inadequate for the pressing highway needs of our communities. While other agencies have contributed and will in the future contribute toward larger state highway funds, continued educational enlightenment

of the public as suggested before must be mainly depended upon for increased legislative appropriations.

In America the condition of the public highways is the best index of the community's intelligence and progressiveness. This need not be so true of a French or German community, because European road improvements are not so much dependent upon a popular vote as upon the plans of an expert board. Again, such communities have always been accustomed to high-class roads, while we unfortunately have always been accustomed to makeshift methods of road construction. Different environments thus determine and fix our ideals. In a real democracy like America it is futile to attempt efficiency by bureaucratic methods, however desirable such a short cut might be. Instead, we must face the problem of how to stimulate the growth of road ideals among our people. In such a democracy as ours, the plan most certain of success is one which employs evolution rather than revolution, and this in spite of the fact that revolution, if possible, would often effect the greatest saving by eliminating transitional stages of development. While we cannot rise to the plane of efficiency secured by bureaucratic governments, state highway departments can greatly improve present road conditions by maintaining a standard of road construction abreast of the most progressive rather than the average ideals of the community. The state would thus be a leader rather than a follower of public opinion. The wisdom of this policy has been questioned in the recent Chicago Road Congress as likely to estrange popular sympathy and support. Such a conclusion seems to the writer quite unwarranted. For if, in deference to a popular clamor, officials yield their own expert ideals as to the proper material or methods of construction, a short-lived and unsatisfactory road is certain to result. In the end both the highway officials and the general community will be disappointed by the rapid failure of the road. If the commission insists upon the proper specifications, while the community may be temporarily disgruntled, the actual service secured by a suitable government is certain to win the approval of all the patrons of the highway in question. The community has thereby been spared an expensive failure, which would have alienated the support of the entire community from the good roads program.

Most of us will agree that such a road has served a most valuable "object lesson." There have been altogether too many object lesson state roads constructed of unsuitable materials or following unscientific constructional methods, all in deference to the wishes of local officials. The states which have only recently entered the road building movement should be able to learn from the sad experience of

some older eastern states. This experience has been extremely expensive to the states concerned and the entire country can well profit by it. It is disappointing to find some states taking up the road question quite independently of the experience of older sister states.

In connection with the object lesson road building of the several states and also to some extent in the so-called experimental roads constructed in whole or in part with state funds it seems that more cooperation between the states would result in conserving road funds. At the present time much needless duplication of experiments and printed reports exists. Is not this matter of sufficient importance to deserve thorough discussion?

In no feature of highway work do our people stand in so great need of instruction and education as in the importance—nay, the absolute necessity—of adequate and systematic maintenance. Countless townships and municipalities are very backward in voting funds for maintenance. Centuries of experience have taught the European taxpayers that the time to begin the repair of a road is the day after its construction is completed. In America, too generally, we put off the repair of our roads until the day after they are worn out. As a result, European roads are well maintained and long-lived while American roads are relatively rough and short-lived. Failure to give attention to this important need has caused a very serious financial condition with reference to future highway improvements. Money which is needed for the construction of new streets and highways in growing communities is required now for the improvement of older highways under circumstances such that, had proper attention been paid to their maintenance, replacements would not now be necessary. In no other construction does the old adage of "A stitch in time saves nine" apply more aptly than in road repair. After a state has improved a thousand or so miles of roads, this subject of maintenance will impress our taxpayers.

Real efficiency, however, requires that they realize the great importance of maintenance from the very beginning of the highway improvement program. Education of the public is the only way to bring this about, and the state highway departments should take a most active part in this propaganda.

It will be fatal to leave this matter in the hands of the local officials, or even county officials. The state should lead the way. The greatest efficiency and continuity of management of our roads will be promoted by placing the maintenance of all state and main trunk roads in the hands of the state highway department, where it should be, outside of the influence of petty township or county politicians.

What can be more logical than the belief that the same authority which designs and constructs our roads will also be the most competent authority to be charged with their maintenance! Can we not all agree that in no better way can state highway departments spend their funds and their energies than in teaching our citizens the meaning of road maintenance?

A question sure to arise is, How can we get the necessary maintenance funds? The writer will only touch briefly one phase of this question. He believes in an adequate automobile and wheel tax. As a matter of fact, heavy trucks, powerful and fast moving automobiles and heavily-laden narrow steel-tired wagons are responsible for a large part of this excessive cost of road maintenance. In all justice to the taxpayer these classes of vehicles should be made to contribute to the state maintenance fund in proportion to the damage they do to the roads. This principle, in fact, has long been recognized and acted upon in Europe.

Instead of a flat sum, often as insignificant as five dollars, our license fees for self-propelled vehicles should be made proportional to the weight or horsepower of the vehicle. While the size of the license fees abroad seems excessive to us, very much smaller fees would suffice to create an adequate maintenance fund. Such a tax can be justified not only on the basis of damage done to the road, but also as coming from a class to which such a tax would be far from a burden.

Automobilists everywhere have shown a willingness to pay any reasonable license fee whenever they could be assured that such funds would be wisely spent on the upkeep of the roads. A wise administration of license fee funds by state highway departments must have a great educational value by demonstrating to town, county and city authorities the great economic importance of road maintenance.

Mention has been made of the growing abuse of our roads by traction engines and by the use of roads by trucks excessively laden and at excessive speeds. This is due to the too common belief in America that because it is a public highway an individual may abuse a road surface as his natural right, even if such abuse results in denying the use of the road to others. Where these views are commonly held it is very difficult to secure remedial legislation. It seems to the writer that state highway departments may well devote some attention to educating the public on this subject by distributing suitable bulletins and by any other means of securing wide publicity. Indeed, some state departments have already rendered most valuable services in such an educational propaganda and can now point to effective regulative legislation as a result of their efforts. We

may well look forward to the near future, when such activities may be the rule rather than the exception.

To sum up the preceding outline, we note that the educational field for state highway departments includes the teaching and preaching, in season and out, of the paramount importance of:

1. A scientific selection and design for each highway improvement.
2. A scientific construction secured by competent and thorough inspection of all the many details.
3. A scientific maintenance of all state roads by a central authority.

At no time in our history has any single state department possessed such remarkable and important opportunities for service to our commonwealths as do our several state highway departments. In congratulating them upon this opportunity, the writer wishes to express his firm belief that they will educate and lead, rather than follow, the public opinion in their respective commonwealths.

CHAIRMAN ALBERT: The discussion of this paper will be opened by Mr. A. D. Williams, chief road engineer of West Virginia.

Discussion by A. D. Williams

When we look over the pages of history we see occasionally a person who has towered above the people of his day, but, being before his time and living and moving on a plane of life different from those with whom he was associated, has not produced the maximum fruition owing to the lack of support and cooperation.

This is true of those leading the highway movement in the past. Years before the beginning of the Christian Era a ray of progress burst forth from the Valley of the Nile and a mere spot on history tells us that King Cheops was a road builder. Nothing more is known of this work but the influence. Carthage caught the spark, lit the new light and passed it on to Babylon and to Rome. The Roman development centered around one man with whose death the progress seemed to stop. Tresaguet, Telford and McAdam have added their mite and passed from the stage of action. They labored so as to leave the world a true legacy. Yet, the things that were suitable to their day and age are not adaptable to our time and conditions. Methods and means of transportation have so changed as to make the problem of the highway one of the biggest, most complicated and difficult that confronts the people of this day and age. It has more angles and effects more avenues of life than any other social, economic or scientific question. The advance-

ment of civilization, the spread of commercial influence, the religious, intellectual, commercial and home life, the comfort and happiness of our people are alike dependent on the improvement of our highways.

The road is the connecting link between the industrial center and the material producing community. It is the greatest factor in the cost of living—a question that concerns all. Yet, with all this importance attached to it we have, as a whole people, until just recently, given the highway problem only passing notice. We have believed that any one could build a road. The problem has not been considered, in many places and by many, a scientific engineering question, because the masses have been trained to think that the time-worn method of remembering the boys that deliver the votes with a job on the road, was right and that merit stood for nothing. Many people feel that money expended in engineering is wasted because they cannot see what the engineer saves and time has not told the worth of durability in construction. This is due to the engineers themselves. They have been trained to stand aloof from the people and keep their work a secret in the interest of their employer. They have met with railroad and other industrial officials to talk over and assist in solving their problems. These concerns have learned the need of engineers and the public here recognizes their usefulness in this field, but the highway that requires all the skill and ability of the railroad engineer and much more has been used as a covering for the local political football.

The engineers have not taken the public into their confidence, but have worked on the high plane of science and culture. This is to their credit, but they are now confronted by the greatest question of the age and they must solve it. It belongs to their field. Other professional men have a place in the solution of the question, but in this field the engineers must lead, and so lead as to bring with them the support and cooperation of all the people. The engineer may be the best that can be found, but in a measure he is helpless without the support of the community and the body for which he is working; therefore, the greatest question that confronts the people who are trying to develop an effective highway system for the country is that of establishing in the public heart and mind a realization of the actual cost, the great economic drain, and social disadvantage of bad roads compared to the saving and other advantages of improved roads, the great loss of a hap-hazard, headless and fruitless road plan compared to a systematized, organized and scientifically arranged and managed road program.

The field of the highway engineer is a big one; so big that it is far from being explored. The scientific questions call for years of labor and research. The sociological side calls

for the highest culture and greatest diplomatic talent available. The administrative work demands the best financial, commercial and business ability obtainable. To get good roads with the available material and funds—roads that will render a maximum of efficiency with a minimum of burden to the community; to know the materials within each community and to show the people the advantages and disadvantages of their use; to ascertain the needs of each community and help devise a system of roads that will meet the needs without producing a burden on the taxpayers; to construct the roads so that they will be an investment to each community; to instill into the minds of the people the need of a knowledge of road materials and the need of the service of a man that has such knowledge, so that they will get a dollar's worth of service for each dollar expended; to impress upon the engineers and the public the importance of a traffic census; to start and assist local officials in studying the road problems, are parts of the educational field of a highway department.

In West Virginia, which was the first state of the Union by legislative enactment to require its road department to be a part of its university, and to attach importance to the educational side of the work, we have demonstrated the importance of the work and the worth of the effort. We have more problems considering our area than any other state. The varied topographical, geological and climatic conditions present every phase of the road question, but with all these difficulties we are making progress of which we are proud and which must be credited to the educational work we are doing.

The first road school was attended by 150 engineers, road supervisors, members of courts and persons interested in road improvement. Our second school was attended by 153 persons of like positions. A trip over West Virginia will reveal that the persons attending these schools have improved the earth roads of the state in every community represented, and the road funds for 1915-16 will be more than six times the amount for 1913-14. The standard of our bridges has been greatly improved and the people of the whole state are awake to their needs so much so that we are taxed to our limits to meet the demands with the funds at the command of our department. So successful has been our movement since placing emphasis on the educational side of the work that more road of a permanent and improved type has been constructed or provided for during the past two years than in the preceding forty years. Our experience proves conclusively that the success of highway development depends upon our educational advancement on every avenue of the highway problem.

The public is being educated to recognize the importance of the trained engineer and his work, and this is placing upon

the shoulders of the engineers of the country the burden of the highway movement to which they must be equal or they will be credited with its failure, and if failure comes now it will be costly to the community, the state and nation. We must not fail. We cannot fail. We shall not fail if we prepare for the duty that confronts us. We must put forth our best efforts and acquire the broadest possible training.

Engineers for highway work must be especially trained in the uses of materials, the effect of climate on materials, and the importance of proper inspection and investigation of all work and materials that enter into the work. This training should be in a department laboratory, office and field work after a regular engineering course is acquired and should be before the young engineer is placed out upon work or permitted to prepare specifications. Much depends upon the emphasis of this thought in our future educational work with highway engineers.

The question of grades, location, alignment and many other important items in the successful highway system are problems for the educational field of the highway departments after the young engineer has pocketed his certificate of theory from the college of engineering. The practical side of highway construction and maintenance is a part of the educational field of the highway department. The field is unlimited.

CHAIRMAN ALBERT: There are so many engineers present that Mr. Williams' paper certainly deserves some notice; perhaps not criticism, but commendation and remarks that are appropriate on the subject.

MR. EDDY: Mr. Chairman, I do not like to detain the Congress, but I do wish to commend the paper just read. I think it is right from beginning to end. I think it is one of the most useful documents that has been presented to this congress so far as I know. There is one thing which I think has been neglected. Human nature is the same everywhere. I have had some experience in New York, Michigan, Illinois and a great deal in California, and I find everywhere that when the truth is persistently placed before the people there always is the sentiment that they want to be shown, and when they are shown what is desired in road work they will come to the front and vote the money that is necessary to employ the engineer to improve the road and build good roads. (Applause.)

MR. SUGGS: Mr. Chairman, I want to endorse the paper read by Mr. Williams. I am not an engineer—yet I am, too. That was discussed by the Legislature of my state, whether I was an engineer or not, when I held the position of state highway commissioner. I told them that I had carried the chain and surveyed on the International and Great Northern railroad and had drawn pay on it. While I didn't hold an

engineer's certificate I had sold saw-mills and cotton gins and I was good enough an engineer so I could put them up and show the other fellows how to run them. I had also engineered three or four men into office. (Laughter.) For those reasons I was an engineer.

I talked to thirty-three hundred township trustees on this subject. About a hundred of them disagreed with me. The others didn't say anything, but the ones that did disagree wrote one hundred and fifty letters each to the Legislature stating that they did not need an engineer. Well, those township trustees have all about gone out of business in Oklahoma. Then we had seven thousand five hundred road overseers. They had seventy-five hundred different ideas about how to build a road. It was a hard matter to get those men to work together. But I don't give up and lay down on a proposition as quick as some men do. I want to tell you it took all the nerve I had to stand up and contend for our rights along that line. We spent twenty million dollars in Oklahoma for roads, and over sixty per cent. of the money thus spent went for salaries of incompetent men. I wanted an engineer. I told them they had to have an engineer. If you are going to borrow money on a railroad proposition if you don't make plans and specifications, profiles, and estimated costs the broker is not going to have anything to do with your bonds, and we can't hope to get money without knowing something about what is going to be done with it. For that reason I contended that we must have an engineer to go and lay out the road along the lines of least resistance, avoiding springy places, impossible grades and so on.

There are three classes of men that have been opposed to employing an engineer; the men that manufacture these tin-whistle culverts, the men that sold them and a few that bought them. They all seemed to be interested in the construction of roads. For years at good roads conventions I got in kind of bad when I talked about the tin-whistle culverts and the toy-tools that were being sold. They didn't like it, but after a while we got the Legislature to listen and now we have a law. This last Legislature passed a law requiring an engineer to make plans and specifications, profiles and estimated costs, giving the grade, the width, and showing the size and location of openings and the kind of material. A bridge that won't carry one hundred and twenty pounds to the square foot don't go in any more in Oklahoma. You go to the man of today and he will say, "Why that is a good thing, but what is in it for me." The man of today will ask that question, "What do I get out of it?" Go to a man of yesterday and he will say, "Well, I paid my taxes always, I have done my duty and don't worry me

about the road business." So I want to say, Mr. Williams, when you come down in Oklahoma you are going to have the boys in the rural schools to demand that they have their road properly surveyed. It is as carefully surveyed as a railroad because we have got that system started down in that country. One county down there undertook to build forty miles of road this last winter and spring. The boys and girls of the different schools were to build that road. They actually completed sixteen miles.

Those boys went out there and had an engineer to go with them. The boys made the stakes and cut them and fixed them to drive according to the engineer's direction. I can take fifteen or twenty good boys and about a dozen girls and go before any county commissioners and I will make them come around to my ideas. They are building educational miles of road. I am doing that for the purpose of getting it established as early as possible because the men of yesterday and the men of today are too busy. I am appealing to the men of tomorrow.

When some men go to the Legislature they want to be brought into some third house and entertained by some road material man or road implement man, some one of that sort, to learn how to write a road law.

There is one county over there in Oklahoma where you can't get a job as a teacher unless you agree to build a mile of educational road. In Stevens county they get a premium of one hundred dollars, fifty dollars to the best mile, thirty dollars to the next, and twenty dollars to the next. All the teachers in the rural schools undertake to build these roads. We had a great, big picnic and barbecue. I made a big speech. I made the biggest kind of a speech, and you know why I made it? A girl teacher in one of the common schools built the premium mile road. I says, "I am afraid for my wife to know how much I think of you." But I was proud of her. She got a man to help her that was a progressive kind of a fellow, a commonsense fellow, and he went after the plans of the engineer and she went and raised the means. When the prizes were awarded that little teacher carried off the prize. I was just so proud of her I didn't know what to do.

The boys take an interest in that thing over there. When the boys were organizing I told them to not put in a weakling as a president of the good roads movement. I told them to put in the captain of a baseball club or the football team as the man for the president of the good roads Association. The boys go out and set the stakes according to the engineer's plans, find out what the grade is, find out where to put the culverts, have a man there to show them how to mix the concrete, show them the proportions. They do the work

themselves. When the road is completed the girls set out trees for the boys. They plant trees along those roads. In a few years they will be able to say that we planted those trees, we planted this tree and that. We are educating the boys and girls to the road proposition along those lines in Oklahoma and I believe engineers will agree with the plan. If a man opposes that plan in my state I ask him if he hasn't got icicles around his heart. The man who opposes it is worse than the infidel. I will prove it and I do prove it down there. Now then, the Bible says, "He that provideth not for his family is worse than an infidel." I believe it. That means homes, books, music, flowers, sunshine and such things, as God Almighty intended for his children to enjoy in this world. This is what good roads mean. It means homes.

A boy can't go today and buy a one hundred and sixty-acre farm, can't go and buy five hundred acres, he is not able to, but you put the roads out there in the country and give him the opportunity to buy ten acres and he has got a home, a home that will make him independent. I don't mean that he should be given that home. When they start to build those roads then the next thing, let the father give the boy a calf and let the girls be given some chickens. She becomes interested in animal life. She raises her little chickens and vegetables. She plants her fruit trees and vines and flowers and becomes interested in her home. Give the boy a pig or a colt and let him take care of it and it is his and he won't want to leave home. He has got an interest there. Sell that boy a part of your land. You can't make a living on it unless you have a road to haul your produce to market. A man that will give his boy a sick pig and let him raise it and make a good, big hog; a weakling calf, and make a good, big cow, and then take it away from him is the worst stealer on earth. A man that will do that will steal anything. I say give it to him and let him become interested in his home, keep him in the country. You can't raise a first-class boy on a twenty-five-foot lot any more than you can raise a first-class woman in a five-story brick building or a rooming house. They don't grow right. They are not the good people like they are when raised in God's pure air. (Laughter.) I don't know how you people are. I am glad the crowd isn't so big. I would rather talk to a dozen interested people than four hundred curiosity seekers, don't you see, because it has more effect. I want you people—if you endorse this sort of work, believe in this sort of work—to start it in your homes and let us carry that word all over this country. I think you ought to be interested just as much as I am. It is as much your business as it is mine and I want every man to feel that way.

Now there is one thing that I advocate that I find some opposition to, and that is a system. I believe that the government ought to build, own, and maintain a system of highways. (Applause.) The government ought to own it just like it owns the Panama canal, rivers and harbors or anything else. There are men who oppose that, but you let the government do that and it will relieve the state, county and township of that burden. It will be one of the greatest assets the government ever had. It will set the example which the states will follow. There won't be any question then about how wide you are going to build that road. The counties and the states will arrange to build the laterals into those national highways. You build a federal road across Oklahoma and every county in that state will build laterals to that road. The state can't build them without going through townships. Are you going to relieve that county burden? Let the county build laterals into the state roads or the national roads as it may be, and then what money the township raises will be to build laterals. The government will set the example and then the state will follow and the county will follow and the township will follow and it will be a system that you can't break. Five hundred million dollars for opening fifty miles of water highway? Why not spend a billion dollars and open a hundred thousand miles of road and serve the people of the states? Have you any objection to it? Keep politics out of it. Keep politics out of it just like you keep politics out of your schools. I believe it is the only way it can be done. I know some don't agree with me about that, but, gentlemen, it is coming. That time is coming when there will be such a system. Those systems will be taken up. The government will set a good example, the state will follow, the county will follow that example and it will be an asset, one of the greatest assets the government will have. It will be one of the greatest assets the state can have. It will be one of the greatest assets the county can have, because it will open this country and give the American boys and girls an opportunity to buy their own homes. I am not excited about it, but I am just in earnest. If you don't do it in fifty years from today this country will be owned by foreign landlords and our brave American boys and girls will be tenants.

I believe that this work is going on. I think all we have got to do is to work in harmony. I am going to keep right on this line and I am going to pledge myself to this congress and every other one, that we will keep on working as best we can.

CHAIRMAN ALBERT: Is there anyone present who wishes to discuss this question further? If not, the meet-

ing will stand adjourned until tomorrow morning at ten o'clock.

The meeting then adjourned until Wednesday morning, September 15, 1915, at ten o'clock.

TUESDAY EVENING BANQUET

A banquet was given at the Hotel Oakland Tuesday evening, under the auspices of the Pan-American Road Congress, in honor of the distinguished guests of the congress. At the request of Acting Chairman MacDonald of the Executive Committee, Charles F. Stern, member of the California Highway Commission, acted as toastmaster. Among those who were called on for remarks were Joseph E. Caine, of the Oakland Commercial Club; George W. Tillson, of Brooklyn; Samuel Hill, of Maryhill, Wash.; Col. W. D. Sohier, of Massachusetts; Walter Coggeshall, of California; J. H. King, of the Oakland Commercial Club, and U. D. Darlington, of the California Highway Commission. Music was furnished by professional singers.

FOURTH SESSION

Wednesday Morning, September 15

JAMES H. MACDONALD: We are going to try and commence this session promptly this morning. I notice that the interest is assuming a little more definite proportions now. I see the ladies are coming to join us. By and by we will have this whole place filled. Before I introduce the gentleman who is to preside over our deliberations this morning perhaps I ought to make a little explanation. The proceedings are only available after the session closes, the printed proceedings, one of the most valuable documents that will perhaps be issued in regard to this great movement in this country. The proceedings will only be available to members in good standing of the American Highway Association and the American Road Builders' Association, and those who pay two dollars for temporary membership. It is obvious to all you gentlemen that we could hardly place the obligation and the expense upon either association, and so we have placed at the moderate sum of two dollars the privilege of securing the proceedings. Now we have outside some ladies who have these temporary membership cards. Your name is placed on the card and we take your name and address from the card and send to you the proceedings when printed. I thought perhaps you would like to know that.

I take great pleasure in introducing to you this morning a gentleman who is widely known in his own state for the disinterested service he renders. He is a member of that splendid commission having charge of the highway improvement

in the state of Illinois. Mr. Gash has been for several years serving in that position. I know you will be glad to know that he will preside over the deliberations of the session this morning. I have great pleasure in presenting Mr. Gash to the convention. (Applause.)

(A. D. Gash then took the chair.)

CHAIRMAN GASH: It is indeed a pleasure to me to preside over the deliberations of this splendid congress at one of its sessions. Illinois is much interested in good roads and in having our roads measure up to the roads of the various states of the Union. We have been a little behind in the past, but two years ago last winter the legislature passed one of the best good roads laws in the United States to my mind. We have thirty-four million acres of land in that state, we have ninety-six thousand miles of public highways and the percent of fifteen in counties of the first class, twenty per cent. in counties of the second class, and twenty-five per cent. in counties of the third class are under control of the state. These have been laid out—and maps made—extending into every community in the state and within four miles and a half of every home where seventy-five per cent. of our people reside. And thirty per cent. will reside within one mile of the system of highways when constructed. We have started out intending at least in the next twenty years, if we do not bond, to build that system of roads of stone, which, when completed together with the natural improvement that is coming to the lateral roads, will give Illinois one of the most comprehensive road systems in the United States of America or in any country. In the language of Shakespeare, "It is a consummation devoutly to be wished," to have this system of roads completed as we have set our ambitions to reach.

Now this morning we want to hurry through our proceedings and get over to the exposition this afternoon. The deliberations of this congress will be at Festival Hall at two-thirty p. m. We will be received by the exposition officials. There will be good music and the presentation of the medals. It is urged that all be on hand promptly at Festival Hall to take part in this afternoon's session. Without further preliminary talk we will proceed with the business of this session.

The first thing on the program is "Roadway Surfacing," by Mr. F. F. Rogers, State Highway Commissioner of Michigan. I take pleasure in introducing to you Mr. F. F. Rogers, who will now address you. (Applause.)

MR. ROGERS: Mr. Chairman, Ladies and Gentlemen: In preparing this paper I have tried to keep in the background somewhat any preferences I may have for any particular type of roadway surfacing, and have rather tried to

present to you what the different states are doing along the different lines of road improvement; that is, the different kinds of materials that they are using for surfaces. Therefore I sent out letters to all of the states which are engaged in highway improvement and I received answers from some twenty-five. In compiling these I have tried to give you briefly the mileage and the percentage of miles of the different classes of roads they have built. This paper is accompanied by a blue print table which shows this more in detail than it would be possible for me to cover in a written paper.

Roadway Surfacings

By FRANK F. ROGERS

State Highway Commissioner of Michigan

It is estimated that the United States has 2,300,000 miles of public wagon roads, about 10 per cent. of which, roughly speaking, may be said to be improved. Only about 1 1-3 per cent., however, of this mileage has been substantially improved with state assistance.

A good roadway must be hard, smooth, fairly free from dust or mud and present a reasonable minimum of resistance to the traffic which it bears, considering the kind of materials used in its construction. In general a road must be satisfactory to its users before it can be classed as a good road.

The materials available for road surfacing are:

1. Common earth, sand and clay, suitably combined or treated with some other materials.
2. Gravel.
3. Crushed rock or other substitutes for macadam such as slag from charcoal iron or blast furnaces, the latter being much preferable.
4. Such combinations of 2 and 3 as may be found advisable, a gravel base with a macadam top or a macadam base and a gravel top.
5. Bituminous macadam (penetration method).
6. Cement concrete, using gravel, crushed rock or slag for the coarse aggregate.
7. Bituminous concrete (the mixing method) by using the materials above named for the aggregate and refined tars or asphalts for the binder.
8. Brick with foundations of concrete, water bonded macadam, gravel or sand.

Which of the above materials should be used for a given road is a problem for the road engineer to solve, and it is usually capable of an economic solution leaving the answer beyond reasonable doubt. However, in many cases available funds limit the choice of materials to those close at hand

and cheapest in first cost regardless of whether or not they are really the most economical, considering the perpetual upkeep of the road. But often the materials have to be freighted from a distance, and when the community is rich enough to build the most serviceable road, the skilled road engineer can demonstrate his usefulness, providing he has persuasive powers enough to overcome local prejudice for or against particular materials and the arguments of men who may wish to sell these or other materials regardless of their fitness for the road in question.

The writer has long preached the doctrine that there is no one best material for road surfacing in all places and under all conditions of soil and traffic, and that almost every available road material can be used to advantage somewhere in such a comprehensive system of roads as is required to serve a state.

The accompanying table shows the mileage of state aid roads of different classes in twenty-five states and the percentage of each class now in use. (See pages 178 and 179.)

1. Sand-clay and top-soil roads comprise about one-sixth of the mileage given (16.4 per cent.) showing that these roads are of considerable importance. They are well adapted to a medium horse-drawn traffic with a somewhat larger percentage of automobiles and can be economically maintained by systematic use of the road drag after rains and the addition of such new material, sand or clay, as may be required.

Kansas reports 758 miles of these roads; Louisiana, 423 miles, and Connecticut, 318 miles, showing that they are by no means confined to the southern states as is frequently supposed, although so far as I know, the top-soil roads are mostly found in that section.

2. It will be noted that gravel is the favorite road building material in most of the states, comprising more than two-fifths of the entire road mileage reported (41.2 per cent.).

Washington reports 3,900 miles of these roads; Michigan, 2,061 miles; Utah, 1,319 miles, and Vermont, 1,053 miles, while three other states report over 400 miles each.

No doubt gravel is used on many roads because it is within a wagon haul of the road and cheap. However, taking Michigan as a fair example, where upwards of 60 per cent. of the state aided roads are built of gravel, I am quite sure that in the majority of cases the travel is not so heavy that an economic mistake has been made by using gravel for road surfacing. In other words, when we take into account first cost, plus maintenance, plus repairs, plus interest on the investment, we will have a smaller total than with most of the expensive types of roads.

On the other hand, the writer has in mind several instances

MILES OF STATE AID ROADS.

State.	Gravel.	Sand-Clay.	Gravel surface. Other base.	Macad. Water-bound.	Macad. Bitum. coated.	Macad. Bitum. penetrat'n.	Bit. concrete. Mix. meth.	Cem't concrete.	Brick.	Miscellaneous.		Total.	Remarks.
Alabama	48.72	65.35	....	8.46	....	....	....	....	....	Chert	9.64	133.47	
										Slag	1.3		
Alaska	32.	....	....	....	....	....	....	....	....		....	32.	
Arizona	....	....	....	....	....	....	....	....	....		....	....	
Arkansas	534.	75.	90.	307.	....	3.	....	30.	....		....	1,039.	
California	....	....	....	....	....	....	....	....	....		....	....	
Colorado	....	....	....	....	....	....	....	....	....		....	....	
Connecticut	327.83	318.17	6.83	527.26	....	39.11	22.95	12.67	0.29		....	1,255.11	
Delaware	....	....	....	....	....	....	....	....	....		....	....	
D. of Columbia	....	....	....	....	....	....	....	....	....		....	....	
Florida	....	....	....	....	....	....	....	....	....		....	....	
Georgia	....	....	....	....	....	....	....	....	....		....	....	
Idaho	....	....	....	....	....	....	....	....	....		....	....	
Illinois	3.	....	....	7.	....	....	....	115.	25.		....	150.	
Indiana	....	....	....	....	....	....	....	....	....		....	....	
Iowa	....	....	....	....	....	....	....	....	....		....	....	
Kansas	153.	758.	....	119.	25.	1.	....	1.35	4.10		....	1061.45	
Kentucky	80.	20.	....	400.	10.	....	....	4.	2.		....	516.	
Louisiana	147.2	423.	....	....	....	9.5	....	....	....	Shell	36.3	616.	
Maine	600.	5.	300.	10.	2.	35.	5.	8.	....		....	965.	
Maryland	....	....	....	....	150.	....	3.	18.	....		....	171.	
Massachusetts.	....	1.89	410.81	189.85	661.08	181.49		5.00	0.44	With bitumin.	115.52	....	
							....	....	....	All others	2.49	1568.57	
Michigan	2060.885	75.671	134.364	829.060	....	....	....	94.185	....		....	3194.17	
Minnesota	1079.	81.	5.	68.	....	5.	....	....	21.		....	1259.	
Mississippi	....	....	....	....	....	....	....	....	....		....	....	

Missouri	....	....	....	....	....	....	....	....	....		....	....	.....
Montana	....	....	....	....	....	....	....	....	....		....	....	.....
Nebraska.....	....	....	....	....	....	....	....	....	....		....	....	.....
Nevada	....	....	....	....	....	....	....	....	....		....	....	.....
N. Hampshire..	....	....	742.40	178.03	....	25.30	....	....	....		....	945.73	.....
New Jersey...	215.8	....	....	320.3	30.8	....	41.5	0.4	....	Shell.....	6.9	615.7	.....
New Mexico ...	....	....	....	....	....	....	....	....	....		....	....	.....
New York	....	1915.	....	301.	41.	233.	2.49	101.	28.	All others.....	7.	2628.49	.....
N. Carolina....	....	....	....	....	....	....	....	....	....		....	....	.....
North Dakota..	....	....	....	....	....	....	....	....	....		....	....	.....
Ohio	46.7	....	....	786.6	7.3	151.5	....	66.3	444.0		....	1502.4	Under contract. 187.2
Oklahoma	....	....	....	....	....	....	....	....	....		....	....	.....
Oregon	....	....	....	6.	....	....	....	12.5	....	Asphalt con....	6.25	24.75	.....
Pennsylvania .	....	....	....	872.19	308.70	90.40	21.15	0.31	87.33		....	1380.08	.....
Rhode Island..	....	....	....	241.	5.	4.	....	....	....		....	250.	.....
So. Carolina....	....	....	....	....	....	....	....	....	....		....	....	.....
South Dakota..	....	....	....	....	....	....	....	....	....		....	....	.....
Tennessee	....	....	....	....	....	....	....	....	....		....	....	.....
Texas	....	....	....	....	....	....	....	....	....		....	....	.....
Utah	1319.06	23.03	226.42	13.49	....	....	....	6.20	....		....	1588.20	.....
Vermont	1053.22	....	....	....	....	....	....	....	....		....	....	.....
Virginia	475.	1158.	....	876.	9.	....	....	....	....		....	2518.	.....
Washington ...	3900.	....	....	271.	....	80.	....	0.90	0.42	Shell 12, Shale 3	....	....	.....
										Granite block.	0.70	4268.02	.....
W. Virginia....	....	....	....	....	....	....	....	....	....		....	....	.....
Wisconsin	500.	100.	100.	650.	200.	5.	3.	120.	2.	Shale.....	90.	1770.	.....
Wyoming	....	....	....	....	....	....	....	....	....		....	....	.....
Total.....	12,575.42	5,019.11	2,015.82	6,981.24	1,475.88	811.30	125.09	595.82	614.58		291.10	30,505.36	.....
Per cent. ...	41.20	16.44	6.62	22.89	4.85	2.66	0.41	1.95	2.02		0.96	100.00	.....

where gravel roads have been built on which the traffic—mostly automobiles at high speed—is so heavy that nothing poorer than cement concrete, asphaltic concrete or brick can be expected to last very long, nor be kept in a reasonably passable condition by constant maintenance. Such roads, however, are carrying a traffic of from 300 to 500 vehicles daily, about three-fourths of which are motor-driven. Such roads constitute but a very small percentage of the gravel road mileage of Michigan, hence they may be considered the exceptions which prove rather than disprove the rule.

The writer knows of many gravel roads where the traffic is between 200 and 300 vehicles daily, with the same percentage of automobiles as above noted, that are standing up admirably and are being maintained at a cost far below the interest on the difference between the cost of these gravel roads and almost any type of more permanent road which might be mentioned.

In Michigan the average cost of the single-track gravel road is about $2,000 a mile, the same width of water bound macadam $4,500 per mile, while cement concrete roads of the same width cost about $7,000 a mile. In the majority of cases the concrete roads are from 12 to 16 ft. wide and cost from $14,000 to $17,000 a mile, or about $1.25 per sq. yd., plus the grading and drainage structures.

From the foregoing it will be seen that the annual cost of maintenance on a gravel road will have to approach about $250 a mile a year before any community can afford to consider any type of road costing $7,000 a mile or more, so long as the gravel road surface is satisfactory to the public. And in many places it is the most satisfactory type of road built.

3. The water bound macadam road represents more than one-fifth of the mileage given (22.9 per cent.) notwithstanding the fact that many people are predicting that this type of road is of but little use under modern traffic conditions.

It will be seen that the sand-clay and the water bound macadam mileages are about equal and approximately one-half of the total gravel road mileage.

Michigan reports 829 miles; Virginia, 876 miles; Ohio, 786 miles, and Connecticut, 527 miles, showing that the water bound macadam is well distributed and by no means obsolete.

While the surface treatment of these roads is the subject of another paper, the writer still believes that proper bituminous treatment of the water bound macadam road after it has been in service six months or one year will enable it to resist automobile traffic sufficiently well to give it a high place among the desirable roads under present traffic conditions.

4. Owing to the fact that the gravel road surface is preferable to that of many other types, many roads are now built having a base of crushed stone, slag or other suitable material with a top surfacing of gravel. Upward of 6 per cent. of all of the roads reported are of this type, New Hampshire taking the lead with 742 miles, while Massachusetts reports 411 miles, Utah 226 and Michigan 134 miles.

The macadam base gives extra supporting qualities for this road, while the gravel surface affords easy maintenance by frequent use of the road drag after rains, with only the addition of enough new gravel to keep the surface free from ruts and holes. Macomb County, Michigan, has a road of this type which is well kept, and after two years the total repairs on two miles of road is reported at only $315.53, or an average of $78.88 a mile a year, the larger part of which was spent in dragging. The travel on this road ranges between 200 and 500 vehicles per day.

A few states are building a combination road, using a gravel base and a macadam top, but this type of road is not to be recommended where the automobile traffic is heavy unless some bituminous surface treatment is provided.

5. Owing to the rapid disintegration of the water bound macadam road under excessive automobile traffic, many forms of bituminous binders have been tried to overcome this difficulty. A bituminous macadam built by the penetration process is usually resorted to. This method of construction is well understood by road engineers. The bottom layer of the road is generally built as an ordinary water bonded macadam filled with stone screenings and rolled. The top layer, which may consist of stone ranging from 1 in. to 2 ins. in size, is then applied and given a light coating of clean ½-in. stone chips, free from dust, which are rolled into the surface. After this the road is coated with some heavy bituminous material (asphalt or refined tar) applied hot, preferably by means of a pressure distributor, using approximately 1½ gals. of bitumen per sq. yd. Another coating of clean stone chips is then applied and the road again rolled. This is followed by seal or flush coat of hot bitumen at the rate of about ½ gal. per sq. yd., after which another coat of stone screenings, ranging from ½-in. chips down to dust, is applied to fill the remaining voids and take up the surplus bitumen. The road may be opened to traffic as soon after completion as the bitumen has set.

These roads constitute 2.7 per cent. of the entire mileage reported. New York is credited with 233 miles of this road. Massachusetts with 181 miles, and Ohio with 151 miles.

6. Owing to the reported cost of maintenance of most of the cheaper forms of road, many communities have been seeking a type of road on which the maintenance would be very small. To many people cement concrete seems to offer

the solution and 1.95 per cent. of the roads reported are of this type. Ohio reports 66.3 miles completed and 187.2 miles under contract. Michigan has 94 miles completed for state reward, with a considerable extra mileage through villages on which no state aid was received, and has some 30 miles under construction which will be completed this season.

While the cost of these roads, as above noted, has reached from $7,000 to about $17,000 a mile, according to width, the maintenance thus far reported has been very small and the writer is quite well convinced that where the traffic runs above 500 vehicles a day, this type of road is well worth considering. Experience in Michigan with upwards of 100 miles of these roads is on the whole gratifying.

7. Since the bituminous macadam by the penetration method so frequently becomes disintegrated, the method of thoroughly incorporating the crushed stone with the bituminous materials in a specially designed mixer is becoming more and more common. Materials prepared in this way are designated as bituminous concrete to distinguish them from the bituminous macadam made by the penetration method.

The foundation may be cement concrete or water bound macadam on which the bituminous mixture is spread and thoroughly rolled, after which it is treated to a surface or squeegee coat of bituminous materials, then covered with stone chips and rerolled. The road can usually be opened to traffic the second day after completion.

The advantage of this method over the penetration process is the thorough coating of all of the stones with the bituminous binder which is seldom or never done by the other method, thus greatly increasing the strength of the bond.

Less than 1 per cent. of the roads reported are of this type. New Jersey reports 41.5 miles and Connecticut 23 miles.

8. Brick as a paving material for city and town streets has been used in this country for upwards of forty years, but except in a few cases it has not been extensively used in road construction until within the last fifteen years. Ohio reports 444 miles of brick paved roadway; New York, 28 miles; Illinois, 25, and Minnesota, 21 miles. No other state has reported more than four miles of brick roadway. The total is about 2 per cent. of all roads reported.

As already stated the writer does not believe that there is any one road surfacing that will best meet all conditions and in this brief paper he has simply tried to point out some of the more important materials now in use, the extent to which they are employed and some of the conditions to which they are adapted.

Every road is a local problem to be solved on the ground after all the data regarding soil, climatic and traffic conditions have been ascertained, all of which must frequently be subordinated to the ability of a given community to pay for any kind of an improved road.

CHAIRMAN GASH: The discussion of this paper will be led by Mr. E. R. Morgan, state road engineer and secretary of the state road commission, Utah.

Discussion by E. R. Morgan

State Road Engineer and Secretary of the Utah State Road Commission

Mr. Rogers has emphasized the importance of gravel as a road surfacing material. He states that over 40 per cent. of the improved roads, reported by 25 states, has been surfaced with this material. Its general availability, cheapness and efficiency, make it probable that the percentage mentioned above will increase in the future rather than decrease, for as the traffic on the more important of the roads now surfaced with it increases, so that economy would dictate that it be replaced by more permanent material, the roads which are not now surfaced will also become more important and will no doubt receive a large proportion of this material.

Utah has a comparatively large mileage of gravel surfaced roads and also a considerable mileage of top soil roads, in which gravel predominates. These roads are reasonably efficient and can be maintained for a less cost than would provide more permanent ones when interest in both cases is considered. Utah, however, is expecting too much of its gravel and macadam roads, as a large portion of these roads are carrying from 500 to 2,000 vehicles daily. These roads are not satisfactory to their users and to maintain them properly would cost considerably in excess of the interest on the sum invested in a concrete pavement or even in one of higher type. Then too, the fact that pavements offer less resistance to traffic is a factor which should not be missed in the consideration of the question. Utah citizens are not blind to these facts, for an era of permanent road building has already come; indeed a considerable mileage of concrete and bituminous macadam roads will be completed at the end of this construction season. Over $200,000 has been provided for such work in Salt Lake County and nearly a like sum in the three adjoining counties. Good sand and coarse aggregate for concrete pavements are obtainable in our principal counties at a reasonable cost, and cement can be obtained at a medium price, enabling us to build 7-inch

pavements for from 90 cents to $1.25 per square yard. A concrete road, which is now two years old, has accommodated approximately 1,200 vehicles daily, about one-half of which have been motor driven, and has cost thus far but a small sum for maintenance.

Closely co-ordinated with the question of the kind of pavement is its width, its grades and its position on the right of way and also the positions of the public utilities. The road between Salt Lake City and Murray is built of blast furnace slag on an 8-rod right of way. The Utah Light and Traction Company has a two-track franchise, approximately 22 feet in width, in the middle of the road; the traffic is divided by the street car lines, according to the direction of travel. The State, in conjunction with Salt Lake County, now proposes to pave the road and the question of width of the pavement, or pavements, as well as position, are very important matters. The franchise under which the Traction Company is operating is not specific in stating that it must pave the right of way when the street adjoining it is paved, and for that reason the proposed road must be of ample width to provide the necessities of the traffic, in case the traction company cannot be compelled to pave its right of way; and it must also extend outward from the outer lines of the company's right of way, so that no technicality will excuse the company from assuming the obligation which the county officials intended it should. At present, the road in question has a traffic of approximately 2,000 vehicles a day. A single pavement of from 18 to 20 feet in width would accommodate the traffic with the future reasonably anticipated. However, it has been decided that two strips of pavement from 14 to 16 feet in width will be constructed and that suit will be brought against the traction company to compel it to pave its right of way. It is manifestly unjust to the taxpayers of the State and County that they should be compelled to buy more pavement than would otherwise be necessary and at the same time provide an exclusive right of way on one of the principal highways of the State.

With this question, the one of width of right of way for a road might be considered. In this case, a right of way six rods in width would undoubtedly serve all of the purposes of this road. This being true, there are four acres per mile of road in excess of necessities, which is now worth $12,000 if it could be used for other purposes. If so used, it would result in lifting an expense and a nuisance from the taxpayers and adjacent property holders. Reverting again to the principal subject—it must be said that the importance to Utah of the sand-clay road is one which should not be overlooked. In addition to the mileage of this type of road already re-

ported, considerable more is proposed for immediate construction, partially on account of the successes thus far obtained and partly because no other materials are available for the sums of money on hand for expenditure. One of the counties of the state is socially and almost politically divided by a practically impassable barrier of sand, more than 20 miles in width. For about one-third of its length, deposits of clay are so located that the maximum haul will not exceed four or five miles, while near the other end of the road is found a deposit of disintegrated clay-bearing shale, which will have to be hauled a maximum of seven or eight miles in order that the road proposed may be built. This piece of road is on the proposed Yellowstone-Grand Canon road; its importance and the successes heretofore obtained with the materials available, warrant the undertaking.

In conclusion, let me emphasize the thought given by Mr. Rogers, that there is no material which should be used in all places and under all conditions; but that the construction of every road is a problem which must be solved in the light of a knowledge of available materials, the service to be given by it, and the amounts of funds on hand to obtain it.

CHAIRMAN GASH: Is there further discussion on this important question?

W. C. HAMMATT: I don't think that sufficient stress has been laid on the condition of the sub-grade for the placing of a pavement or surfacing. An old road which has been used a great number of years and which has become compacted to a considerable depth, will support a type of pavement which a new road will not carry. I have a few notes on that subject which I would like to read.

Discussion by W. C. Hammatt

There is no branch of engineering where there is a greater difference of opinion and more discussion leading to no definite conclusions than that of paving practice. Every type of pavement has its advocates, and each is able to give definite examples in support of the particular type advocated. At every convention that I have attended hours have been spent in heated discussion of the different types, and examples galore have been cited where one has failed and another has given satisfactory service, followed by a reversal of the evidence by another speaker. Let us get at the root of the apparent contradiction.

I have always considered a pavement, in its true sense, as merely a wearing surface, adapted to the traffic conditions of the particular locality, for the purpose of protecting the roadway. The soil of the roadway itself supports the

load. Where the roadway is of a nature which will not support the load, the pavement ceases to be a pavement and becomes a bridge. The present practice seems to tend toward the construction of bridges, but due to the unfortunate fact that conditions of support are varying and ununiform and incapable of accurate determination, the engineering work is apt to be faulty. Cheapness of construction is also one of the main points striven for, which has tended toward a flimsiness of construction not in keeping with the practice in other engineering structures of this period. If, instead of attempting to adopt a certain type of pavement to conditions as we find them, we should take those conditions and design a structure to meet their needs, we would be following more nearly the lines of engineering practice in other fields.

In most of our old traveled roads and streets, the subgrade is in proper condition to place a pavement. Years of travel, with the necessary repairs, dragging, filling ruts, etc., have made the earth compact, so that with the shaping and rolling of the surface and the necessary provision as to drainage, the roadway may be expected to support a pavement of almost any type. This is particularly true of metaled roads, where gravel has been added from year to year until the grade is composed of compact material to considerable depth. Thus we see that the most traveled streets of a city, which are usually the oldest ones, generally have their pavements in the best condition. Where possible, I consider it advisable to maintain a new street by metaling alone for a period of years, before attempting to place a permanent pavement. By means of sufficient rolling a new road may give the appearance of compactness, but the effects of the rolling are of slight depth, and settlement may occur where least expected. Railroad companies expect to expend far greater sums on ballasting during the first few years than they do thereafter, and realize that an unsinkable track is an impossibility. So why should we expect more from a highway?

Where it is impossible to wait until a street grade can become properly settled and compacted by traffic, the pavement becomes a bridge, and we must face the fact that the customary pavement construction is inadequate in many cases. To this we must lay the fact that the average life of our pavements is so low and so far short of expectations, and not to slight differences in detail of the paving surface. The Romans built pavements to last, and they have lasted on account of their thickness. Telford's road was on the same principle and was the most permanent of modern pavements. McAdam would be surprised and shocked to see one and two course roads four inches in thickness built under his name at the present day. This practically has led

to the fallacious belief that a macadam road will not stand the present day traffic conditions.

The conclusion from the foregoing is that although we may be obliged to improve by paving roadways unfitted to support such pavements, we should do so with the expectation of a life for said pavement in accordance with the thickness of the base or foundation employed; and that we should not lay its ultimate failure to the type of wearing surface used. Also, in deciding the type of work to be done, one of the things to be considered is whether the expenditure of a few hundred dollars per mile per year in metaling the road prior to placing a permanent pavement would not be more economical than replacing a thin pavement of a permanent type after a comparatively short life.

MR. HAMMATT (Continuing): In this connection I was glad to hear Mr. Rogers' remarks in regard to the proportion of gravel roads which we had and the results which were being obtained from them and his conclusions that the gravel road is really an economical road, considering the maintenance cost and the comparison of maintenance cost with the interest on the excess investment of putting in a more permanent pavement. If we maintained the graveled roads for a greater period until the road was in condition to support a more permanent surfacing it sems to me that we would be in better condition to place the surfacing, and therefore surfacings which would have a longer life thereafter.

MR. ROY: I merely rise to a point of privilege. In listening to Mr. Rogers' excellent paper, every word of which I enjoyed, owing to some oversight probably of our department I noticed he left us off the map a reference to the brick roads. I just want to state that we have in our state about thirty-seven miles of brick roads. We would have more if it was not for the cost being from twenty-eight to thirty-two thousand dollars a mile. We can't quite get money enough to build that kind of road, but in some localities that kind of a road is almost imperative, especially where we have the greatest congestion of traffic and in our dairying districts.

CHAIRMAN GASH: I would like to ask you how wide the roads are that cost from twenty to thirty thousand dollars a mile?

MR. ROY: Sixteen to eighteen feet.

CHAIRMAN GASH: Are there others who would like to discuss this question?

MR. CARLTON: I would like to ask if any one has ever had any experience with a reinforced concrete road?

CHAIRMAN GASH: Can anyone answer the question?

MR. McFADDEN: (Orange County): In Orange county we have a good many conditions of soil to contend with,

and one is peat beds. We have built two stretches of concrete roads across peat beds and they have proved very satisfactory so far. The road has settled a little bit, but there are no cracks in it and it is holding up under very heavy traffic.

DR. PRATT: I just want to say a word on the general subject of surfacing materials as a supplement to what I said yesterday morning on the question of location. I stated at that time that I believed in many of the states we were making a mistake by not being more careful with the exact location of our roads, and that we were putting in grades which we would have to change within five or ten years, we will say, so that we could build a larger mileage of roads. I stated then that it was my belief that we should never sacrifice the location to simply get the greater mileage of roads. Now when it comes to surfacing materials if we have got our location so that there is no question at all in the years to come of the re-location of that road, we should then consider the surfacing materials as to what surface the traffic itself will demand. If the traffic over the road we are to surface is a hundred vehicles, or fifty to one hundred vehicles a day, it does not demand the same surfacing material as a road that is going to carry a traffic of from five hundred to a thousand or fifteen hundred, or, as Mr. Morgan said, two thousand vehicles a day. Now we can on such roads with a low order of traffic put in the cheaper and lighter surfacing materials, such as sand clay, top soil, gravel and so forth, and extend our mileage by not putting in the higher grade surfacing material. I think it is a mistake where you are limited in funds to go ahead and put in, where the traffic does not demand it, the more expensive cement concrete or brick pavements as a surfacing material when the gravel or sand clay or top soil will do just as well. The big advantage to my mind of the use of such materials is that as the traffic increases and demands the harder surafcing material you have had the use of the lighter materials for a series of years, and when the time does come to put on a heavier surfacing material you have got the foundation that is almost absolutely perfect to hold a better, higher and heavier surfacing material. We can by using the lighter materials increase the mileage that we can build with the money available. (Applause.)

MR. MORTON (California): In answer to the gentleman's question in regard to reinforced concrete, while it is not a road and was not built as a road, but was merely built as a pavement at the beach resorts in southern California, Santa Monica and Venice, we have laid a sidewalk that is intended only for pedestrians. It has been down now from five to seven years and we have been using it every time we

have a parade. You all know we are very partial to parades in southern California, and in them we run trucks over this sidewalk all the way from five to six and eight tons. It is some four or five miles in length. The greater portion of it is reinforced with ordinary chicken wire fencing and so far from one end to the other we have not discovered a crack or check in it. I have felt for a number of years that this was a good pavement. We use it during our parades and whenever we want to show off anything and believe that the reinforcing is very beneficial to concrete roads.

MR. WHITE: Do you have expansion joints?

MR. MORTON: We have expansion joints every fifty feet.

MR. LODER: I would like to call attention particularly to what the gentleman from southern California has said about the sidewalks in Venice and Ocean Park. They are laid on the driest beach sand you can imagine, nothing whatever to hold the screen together. The sand is just as dry as any sand you could possibly obtain anywhere. It is loose, absolutely no binder, and if a thin reinforced concrete slab will carry five-ton trucks, heavy traffic, and will not break or crack it is a pretty good testimonial for a thin concrete road. I believe he has very little reinforcement in it from what he says, thin chicken wire fencing material, and of course that is necessary. I don't think that the concrete would stand on that sand without some reinforcing. On the state highway we are using a great deal of four-inch concrete road without reinforcing. We are having little or no difficulty with it in setting unless we are on bad foundations. There we either improve the foundation by putting in better sub-grade material or make the concrete a little thicker. I would like to bring out the point and have some one answer it as to the effect of reinforcing on the expense of laying concrete road. We have not tried it on the California work to amount to anything, but it has been our idea, at least my own in observing it and studying the proposition, that it would add a good deal to the cost of laying the road because that reinforcing material must be handled behind the mixer and in front of the placing. In other words, it must be handled under the distributing spout and it will limit the speed of the crew, and I would think add quite a little to the expense. It is also a question in my mind how the reinforcing material would be handled in order to get it in the proper position in the slab so that it is not lying on the ground.

MR. HAMMATT: I can give some kind of an answer to Mr. Loder's question. I recently had the laying of a concrete base over quicksand, a place where I was obliged to reinforce concrete on account of the quicksand sub-grade. It was originally designed as a straight concrete base. I intro-

duced the reinforcement in it when I found that we ran into the quicksand. On that the cost of reinforcing was about one cent, was almost exactly one cent, per square foot. The additional cost of laying the concrete due to the placing of the reinforcement was less than one cent per square foot additional, making the total additional cost less than two cents per square foot. One reason for the low additional cost of laying was the way that it was put in. It was placed there one inch from the bottom. The fine aggregate of the concrete was laid on the bottom, and struck off to approximately one inch in thickness. The reinforcing was then laid directly on and worked down into the concrete as laid, and the additional depth of concrete was then put on top of it so that there was no necessity for the accurate placing of it providing the striking off of the original layer was accurately done. The weight of the reinforcing for the concrete road was forty pounds per one hundred square feet.

CHAIRMAN GASH: Now we will have to proceed rapidly. I would like to go on with this discussion, but there are other papers that we must hear. Before proceeding with the next topic I would like to especially emphasize the automobile trip for Saturday to San Jose, around the bay and back on the other side up through San Francisco and across the way back to the Oakland Hotel. The machines will be ready and we will start on that trip promptly at nine o'clock in the morning. It is necessary, of course, that all be registered on that trip. There will be no expense in connection with it.

Now this afternoon it has been so arranged that at the meeting at the exposition for the members of this congress, they will be especially conducted through the places of special interest to them. The buildings will be kept open for those wearing badges. In order to get a badge you must register at this congress. The program for this afternoon is as follows:

Afternoon session in Festival Hall, Panama-Pacific Exposition. Presentation of commemorative bronze medals by officers of the exposition. Acceptance and response by Mr. Geo. W. Tillson for the American Road Builders' Association. Acceptance and response by Mr. S. E. Bradt for the American Highway Association. Acceptance and response by Mr. C. L. MacKenzie for the Tri-State Good Roads Association. Acceptance by Mr. Samuel Hill, President of the Pacific Highway Association. Then we will have the regular program as printed in the programs which you all have. I am sure that you will all enjoy this program over there, and all who have been in attendance at these meetings will enjoy this program. Likewise you will enjoy the trip on Saturday, and we urge all the members of the congress to go.

The next topic for discussion is "Resurfacing Old Roads,"

by Mr. W. D. Uhler, Chief Engineer of the State Highway Department, Pennsylvania. I have pleasure in presenting Mr. Uhler. (Applause.)

Resurfacing Old Roads

By WILLIAM D. UHLER

Chief Engineer, Pennsylvania State Highway Department

One of the most important problems confronting road authorities today is the question of resurfacing or rehabilitating old stone roads. This condition in most cases is the result of neglect. Failure to make repairs or to restore the worn-out portions before a road has deteriorated through to the foundation necessitates the rebuilding of the road and a large expenditure; whereas, through skilled maintenance, the outlay can be reduced materially and spread over a period of years. There are, of course, other reasons for resurfacing old roads, as, for instance, the improper selection of the original material, which is responsible for rapid deterioration; and the constantly increasing and varied traffic causing abrasive action too severe for the type of road. This latter condition is noticeable particularly in suburban communities and communities where water bound macadam roads were laid in the early stages of development, and where the population has increased rapidly and where all classes of vehicular traffic have caused the original roadway to deteriorate more rapidly than would have been the case had the development not occurred, thus creating the necessity for repairing and resurfacing in order to make the wearing qualities of the road as good as those in the nearby cities.

The essential points to be considered in the selection of a proper type of surface for an old stone road are the character and amount of traffic, the grades, and, as a rule, that most important factor, the funds available for the work. When the traffic has been determined and the character of surfacing selected, a thorough study should be made of the existing foundations and drainage facilities. Many surfaces have been sacrificed for the want of proper attention to the foundation, and too often it is taken for granted that any stone road is a suitable base for almost any type of surface. Test holes should be made at sufficient intervals in the road to determine the depth of the existing foundation, and usually it is found that a considerable portion must be restored before a surface can be applied. Irrespective of the type of surface selected, the preparation of the foundation must be given the same careful attention. Too much stress cannot be laid on the desirability of having proper lines and grades before resurfacing, in order to avoid increasing or perpetuating the difficulties of future improvement of these roads.

The question of providing proper underdrainage must be considered and drains installed where necessary.

In order that the various methods to be employed may be described conveniently, this paper will be divided into the following classifications:

First: Water bound and bituminous macadam.

Second: Bituminous concrete and sheet asphalt.

Third: Vitrified or other block pavement.

Water Bound and Bituminous Macadam

The methods used in the preparation of the base for both water bound and bituminous macadam are the same. If any holes or depressions are found in the base, the road should be dug out and replaced with good sized, clean stone, keyed with a smaller size, and rolled with a 10-ton power roller until thoroughly compacted. The roadway should then be cleaned thoroughly and the existing surface broken or loosened with picks, harrows, or, if necessary, rollers equipped with spikes, so that the new material will bind properly with the old surface. Where the new surface is wider than the old base, or where, in improving the line, it rests partly on the old surface and partly on the old shoulder, it is necessary to provide a new first course or base where an old one does not exist, in order to support properly the top layer or wearing surface.

After the base course has been finished, there should be laid a layer of properly graded, approved stone, passing a 2½-in. mesh screen and be retained on a 1-in. mesh screen, this stone being known as "1½-in. stone." The stone should be spread upon the base course with shovels, from piles along the side of the road or from a dumping board, but in no case should the stone be dumped upon the first course surface. This layer should be rolled with a roller weighing not less than ten tons until it is compacted to a firm and even surface. The total thickness of the surface course should be not less than 3 or 4 ins., after rolling. When a surface course of a depth of 3 ins. is specified it should be laid in one layer, and a 4-in. course should be laid in two layers of 2 ins. each.

Should difficulty be experienced, while rolling, in getting the stone to compact thoroughly, sprinkling with water or spreading lightly with screenings will prove beneficial.

After the surface course of stone has been thoroughly rolled, screenings, varying in size from dust to ¾ in., should be spread, with shovels, from piles along the side of the road, or from dumping boards, but, again, in no case should the screenings be dumped directly upon the surface of the stone. These screenings should then be thoroughly rolled with a 10-ton steam roller, additional dry screenings applied, and the rolling continued without the use of water until the inter-

stices of the stones are filled. The road should then be sprinkled with water, rolled, additional screenings spread and the sprinkling and rolling continued until the surface is well bonded and set. The rolling in all cases, should begin at the sides and work toward the center of the roadway, thoroughly covering the area with the rear wheels of the roller, and should be continued until the surface is hard and smooth and shows no perceptible tracks from vehicles passing over it.

To protect a water bound macadam road from the ravages of automobile traffic it should be given a bituminous surface treatment of either approved tar or asphalt. Prior to applying this bituminous material, the surface of the road should be cleaned thoroughly, by sweeping with machine and hand brooms. After all the caked dust has been scraped off and the stone exposed uniformly over the surface, the bituminous material should be applied.

Bituminous Macadam

In resurfacing with bituminous macadam the base course should be prepared as for water bound macadam, after which broken stone passing a 2½-in. screen and retained on a 1-in. screen should be spread on the base course with shovels, from piles along the side of the road, or from a dumping board, to a depth of 3 ins., after rolling. After the broken stone has been laid and placed true to line and grade and cross section, it should be rolled, with a roller weighing not less than ten tons, until the stone has been thoroughly compacted and ceases to creep in front of the roller. When the rolling has been finished, there should be spread evenly over the surface a quantity of approved bituminous binder, not less than 1½ nor more than 1¾ gals. to each square yard of surface area. The binder should be heated to the proper temperature for the material used.

After the bituminous binder has been applied, there should be spread a layer of ¾-in. dry, crushed. approved stone, free from dust, and in such quantity as will just cover the surface and fill the surface voids. Rolling should then be continued until the surface is thoroughly bonded; the surface then should be swept clean of all loose stone and an application of bituminous binder, of approximately ½ gal. to the square yard of surface area, applied evenly. This binder, in turn, should be covered immediately with a thin layer of dry stone chips, free from dust, and rolled lightly. The quantity of chips should be just sufficient to absorb the excess of bituminous material remaining on the surface and to prevent the existence on the surface of an excess of binder.

Bituminous Concrete and Sheet Asphalt Resurfacing

Bituminous concrete and sheet asphalt pavements should be laid on a concrete base, instead of on the old existing mac-

adam foundation which, heretofore, has been the generally accepted practice for country roads. In view of the increased amount and change in character of traffic, even though slightly more expensive, it is advisable to provide for either a 4-in. or a 5-in. concrete base on top of the broken stone or telford base, due to the tendency of macadam to shift or to consolidate further under traffic and possible sub-grade trouble, all of which tend to bring about a wavy or uneven condition of the surface.

In resurfacing old water bound macadam roads, where the base consists of either telford or macadam, the broken stone surface should be removed to a depth sufficient to conform to the required cross section and grade. Where the telford surface is exposed the irregularities are broken off with a napping hammer and the depressions filled in and upon this prepared surface is placed a 4-in. concrete base, mixed in the proportions of 1:3:6, laid so as to secure a very rough but regular surface to form a bond between the concrete base and the bituminous top. In conjunction with the concrete base a concrete header curb should be constructed extending 6 ins. beyond the fixed edges of the bituminous pavement and to the finished grade. After the concrete base has developed a hard set, and from one to two days prior to the placing of the bituminous wearing surface, the base should be cleaned thoroughly of loose and foreign material, by sweeping, and then covered with an asphaltic cut-back mixture consisting of equal parts, by volume, of asphaltic cement, 55 to 65 penetration, and commercial naphtha, 52 to 55 gravity, the mixture being applied by a pressure distributor at the rate of ⅛ gal. to the square yard. The object of this paint coat is to secure a better bond between the concrete base and the bituminous top. The bituminous top, 2 ins. in thickness, is laid under the same requirement as to preparation, laying, rolling and inspection as for a standard sheet asphalt pavement.

The following penetrations are recommended for the asphaltic cement:

	Heavy team or motor traffic.	Medium or light traffic.
Trinidad asphalt	45-50 penetration	50-55 penetration
Bermudez, Mexican and California	50-55 penetration	55-60 penetration

Experience has demonstrated that the turning of traffic on and off a bituminous surface will result in grinding or cracking the edges and also, unless a perfect bond has been secured with the base,—and this cannot be relied upon—heavy wheel loads, at a distance of 1 to 2 ft. from the edge, will produce a spreading of the bituminous surface. To prevent this, provision should be made, no matter what the formation may be, for a 6-in. concrete header curb on either side of the road if it is not paved to the full width.

In resurfacing with a sheet asphalt top, the concrete foun-

dation should be laid true to line and grade; and the binder and wearing surface laid to a uniform depth and raked to true cross section and grade, after which it must be rolled thoroughly.

Unquestionably, the most important single point in the laying of sheet asphalt wearing surfaces is the rolling. More pavements are failing today through displacement from original form than from all other causes combined, and aside from other reasons to which this result may be attributed—and there are undoubtedly many—it is certain that unless a pavement is free from waves at the time of its completion it never will be, as the tendency of the pavement is to push under traffic, thus increasing the wavy condition. It is important, therefore, that all pavements should be thoroughly compressed, carefully rolled and cross rolled.

In the preparation of bituminous mixtures all materials should be subjected to rigid plant and laboratory inspection.

Vitrified Brick and Other Block Pavements

Where the character of traffic demands block pavements, it is poor practice to lay them on other than a stable foundation. Under these circumstances, it is, as a rule, more economical to use either a 5-in. or 6-in. concrete base, the depth depending upon the character and volume of traffic for which it is designed. If a concrete base is used, it should be laid true to line, grade and cross section, after which a sand cushion should be spread to a uniform depth of from 1 in. to 1½ ins. This cushion should be shaped carefully, to a true cross section, by means of a templet having a steel faced edge covering at least half the width of the area to be paved. The cushion should then be moistened slightly and rolled over its entire surface with a hand roller. After rolling, the templet should be drawn over the surface again to shape the cushion finally.

The blocks meeting the required test should be laid on edge in straight rows at right angles to the curb, except at intersections, which should be paved at an angle of 45 degrees to the center lines of the intersecting roadways. After the blocks, as laid, have been inspected and approved for rolling, and the surface swept clean, the pavement should be rolled with a self-propelled roller, weighing not less than three, nor more than five tons. The rolling should commence at the edge and continue back and forth toward the center until the center of the roadway is reached, then the opposite side should be rolled in like manner. The pavement should then be rolled transversely at an angle of 45 degrees, repeating the operation in the opposite direction. Before and after this rolling has taken place, all broken or injured blocks should be removed and replaced.

After thorough rolling, the joints should be filled with

grout, composed of one part clean sand and one part Portland cement. Special attention must be paid to the mixing and placing of the grout; the standard practice recommended by the National Paving Brick Manufacturers' Association should be followed. Soon after the joints have been grouted and the cement filler has set, the expansion joints next to the curb should be poured. Attention also should be paid to securing a proper bituminous filler, which will not be too brittle in winter nor too soft in summer.

The same general practice as here outlined for vitrified block pavement is applicable to a more or less extent in the laying of either granite or wood block, the difference, as a rule, being that in the laying of granite block the sand cushion is from 1½ to 2 ins. in depth. The blocks should be sorted and gauged, those of the same width and depth being paved in consecutive rows across the full width of the road and rammed with hand rammers instead of being rolled, after which they should be grouted with a cement grout.

In paving with wood block a layer of mixed sand and cement 1 in. in thickness, mixed dry in the proportion of one part Portland cement to four parts of sand, should be spread upon the base and brought to a surface parallel to the grade and contour of the finished pavement.

Prior to the laying of the wood blocks this cushion of sand and cement should be sprinkled lightly with clean water and the blocks immediately set thereon. Care should be taken to set the blocks with the fibre of the wood vertical, in straight parallel courses, at right angles to the curb. After laying, the blocks should be rolled with a self-propelled roller weighing not less than three nor more than five tons and the joints then filled with fine, clean, dry sand passing a 10-mesh sieve.

No attempt has been made to give in detail the specifications for all classes of material entering into the various methods of resurfacing, as this information can be obtained from any of the standards now in use.

The foregoing description, however, covers in general the methods employed in resurfacing work but, in order that the best results may be obtained, there are several points which should be emphasized in summarizing the subject.

In the resurfacing of water bound macadam it is frequently the case that the engineer in charge of the work allows too small a stone to be used, which, it is true, will require decidedly less rolling, but will not stand the motor traffic of today.

Another fault quite often found is the spreading of screenings before the 1½-in. stone is thoroughly locked, and very frequently using too large quantities of screenings, thereby causing a heavy crust to form on the road surface.

The success of the bituminous treatment of water bound

macadam roads depends entirely upon the cleanliness of the road before the application of the material. Many failures are due to the lack of proper care in this most important detail. In cleaning the surface of the road, the sweepings should be windrowed along the edges of the wearing surface, in order to prevent the running off of the bituminous material, which later should be swept back on the road. Special attention should also be given to applying the chips, just sufficient chips being used to prevent the traffic from picking up the bituminous material.

In bituminous macadam or penetration work, no bituminous binder should be applied unless the stone surface is thoroughly dry, and the temperature of the air is 65° F., or higher. Special attention should be paid to the heating and applying of the binder.

One of the important features in connection with obtaining the best results in bituminous concrete construction is the use in the wearing surface of good, hard, durable stone, free from dirt and decomposed material, as decomposed stone in the mixture will naturally develop weak spots in the pavement and ultimately result in failure.

The penetration of the asphaltic cement used in the mixture should be governed by the character of the traffic requirements.

As before stated, the success of all bituminous concrete and bituminous pavements is very largely dependent upon the rolling, and the best results can be obtained only by using a light roller for the initial compression and a heavier roller for the final compression, with an equal amount of transverse and longitudinal rolling.

In the laying of sheet asphalt or bituminous concrete, where brick gutters are used and adjacent to block runners along car tracks, it is good practice to lay the finished surface of the pavement from ⅛ to ¼ in. higher than the brick gutters or runners. It is difficult in the rolling to secure final compression next to these blocks, and traffic will further compress that portion of the pavement, naturally causing the development of low spots which hold water and result in deterioration.

Special attention should be paid also to the heating of the various aggregates entering into the pavement and also to the combined mix, as many failures are caused by over-heating. No over-heated material should be used under any circumstances, as failure is bound to result.

In vitrified block paving avoid the tendency to place too great a depth of sand cushion, as latter day experience has proven that the sand working up in the joints has been responsible for many failures, and the success of the pavement is dependent very largely upon the method of mixing and applying the grout filler. The grouting, although a simple

proposition, has in many cases been handled so carelessly that the success of a good pavement has been destroyed.

The practice of placing transverse joints in brick pavements appears to be unnecessary, as the curb joints generally will suffice.

In laying wood block pavements, care should be taken to see that the wood blocks are properly protected from the elements when delivered on the job and before laying, as too frequently the material is delivered along the line of the work so far ahead of the laying that the blocks dry out, and, after placing, if they become saturated, undue expansion results.

The old road having been resurfaced, its life and success depends upon maintenance, which in turn depends largely upon attention to details. A patrol maintenance system will do more to preserve roads and pavements, and prevent deterioration, than any one thing.

The trouble in the past has been that the average engineer has been interested only in the construction end of the work, while the most important problem confronting the road engineer of today is the rehabilitation and proper maintenance of the old resurfaced roads.

The following paper opening the discussion was read by title, Mr. Travilla being absent.

Discussion Opened by James C. Travilla

Highway Engineer, Fort Worth, Texas

In resurfacing old roads local conditions should govern the material used and method of construction. The engineer must make his recommendations based upon the mileage of roads to be resurfaced, the available funds and material, character and amount of traffic, climatic conditions, etc. There is such a wide range in the kind and quality of material suitable for resurfacing that there can be no comparison between roads resurfaced with the best lime or trap rock or sharp sand bonded together with bituminous cement, as compared to a soft white lime rock or inferior gravel or sand and clay treated with a light oil or tar. The best material and methods of construction are none too good to meet the changed traffic conditions, as the auto truck and the farm tractor are in evidence everywhere on our roads. The damaging effect of this traffic and the increased cost for maintenance resulting therefrom is a matter for careful consideration by the highway engineer.

The resistance of any road metal to wear and deterioration from traffic and climatic conditions depends in a large degree upon uniformity in the hardness and in the grading. Comparatively soft stone or gravel uniform in texture and hardness will produce a road surface that will wear uniformly

throughout its life, as compared to a mixture of hard and soft stone. The grading of a soft road metal will produce a better road surface than any hard metal not uniformly graded. The lack of uniformity in the grading of the stone or gravel is due to the screening or the dumping, and may be corrected by harrowing the road metal with a field harrow. The importance of the scarifier, grader and roller for road work are fully recognized, but the field harrow can do more to produce a better wearing surface and reduce the amount of rolling than is generally understood. By this treatment of the mineral aggregate many of the inherent weaknesses in road resurfacing are removed and a road obtained that will be practically free from "chuck" holes and wear uniformly. It is important to recognize this feature in highway construction, and if properly observed there will be less need for resurfacing. The slogan for good road construction and resurfacing should be "Uniformity and Attention to Details."

Wearing Surface

The wearing surface of any road is what appeals to the users of highways. If it is smooth, free from dust, resilient and lasting it will be well advertised. The publicity man, however, does not take into consideration the available material, climatic conditions, character and amount of traffic, and assumes that a road which is carrying a large per cent. of pleasure traffic in California will serve the heavy steel tire traffic on a road leading from his home city. He urges its construction to the local engineer, but as neither one has had the opportunity to study the successes and failures in the construction and resurfacing of roads his recommendations ofttimes prove failures. These problems are receiving the attention of engineers and will be solved. The difficulty will be in the application of the chosen methods to meet the local requirements.

The automobile, auto truck and tractor have been partly responsible for the resurfacing of old roads due to the damaging effect from their use and to the demand of owners of cars for a better road surface. It may be presumed in this paper that any resurfacing of old roads to be considered will be by modern methods.

In the resurfacing of old roads vitrified brick, Portland cement concrete, asphaltic concrete, asphaltic macadam, heavy and light asphaltic oils and refined tars, with covering materials, and oils and tars as dust preventatives have merit and value. The opinions of the material man and the taxpayer inexperienced in road work should not, however, govern in the selection of materials. The oils, tars, and asphalts, on account of their low first cost and availability, are more generally used for the top finish, and I shall confine this paper to their use.

In the treatment with light oils and refined tars the roadbed should first be properly shaped. The surface should be free from dust and the oil or tar applied at the rate of one-sixth of a gallon to the square yard, making several applications and allowing each one to set thoroughly. This treatment is recommended where the mileage is large and the funds limited and where there is much pleasure auto traffic. No permanent results are obtained, but the mineral dust is held on the road which reduces the wear from abrasion and eliminates the dust nuisance. This method of surface treatment is popular on account of the low first cost. The oil or tar is applied cold and in such a small quantity to the square yard that no covering material is required. It is not objectionable to the traveling public. Some oils act as lubricants to the road metal, prevent the mixing of stone dust with the water when making repairs, which is an objectionable feature in maintenance work. The oil should be an asphaltic base product with a gravity of about 20 degrees Beaume, and the refined tar a specific gravity of about 1.07. Better results will be obtained with the oil where the road surface is a sand or flinty gravel. Where the mineral matter is limestone refined tar will produce better results than are obtained with sand or gravel. A better and more lasting surface may be obtained when the heavier oils and tars are used. However, a covering of sharp sand, gravel or stone chips is necessary to prevent the picking up of the bitumen. In the use of the heavy oils and tars it is necessary to have a compact road surface and not to apply an excess of oil or tar.

Asphaltic cement, heavy oils and refined tars are generally preferable to the lighter products in the resurfacing of old roads. To obtain satisfactory results from their use, experience and attention to detail is necessary. A road surface that carries an excess of stone screenings or dust cemented in thin layers will be a failure, as the bituminous mat or carpet will break up or peel off. The road surface should be compact and free from an excess dust. In using asphaltic oils the larger stone in the roadbed should be exposed and the surface slightly pitted so as to obtain a mechanical bond. This pitting is best accomplished by sweeping the road surface. It is desirable to sprinkle the road with water in advance of the application of oil, as the water moistens the dust on the stone that is not removed by sweeping and assists in producing a bond between the old and new surface. In the use of refined tars a dry surface is necessary. The spreading of the stone chips immediately following the application of oil or tar is an important detail. It will prevent an excess of oil or tar on the edges and quarters of the road and if not given sufficient attention

the surface will show "fatty" spots and be corrugated. I have found stone chips passing the one-half inch mesh and free from dust to give the best results. An excess of stone dust will destroy the life of the oil or tar. The oil used should be a gravity from 10 degrees to 16 degrees Be., and the refined tar 1.06 to 1.20 gravity, depending on material used and the method of construction.

An improvement in the resurfacing of old roads over a single application of bitumen is to apply two treatments, using a light product as a priming coat and a heavier product as a binder. The light material acts as a penetrant which ties or bonds the bituminous mat to the old road surface.

Refined tars do not always run uniformly. They are more readily affected by atmospheric conditions than the asphaltic cements and heavy oils. I have examined road work where refined tars had been used as the binder and found the lighter oils to have volatilized and the road metal badly ravelled. On the other hand, I know of tar concrete used for foundation in street paving that is in good condition after having been down more than thirty years. From experiments of others and my own experience I should recommend for surface treatment two applications. First, a light coat of refined tar, followed by an application of asphaltic cement. Before applying the asphaltic cement allow the tar to set for twenty-four to forty-eight hours. The stone for two application work should be graded from that passing one inch mesh down to dust. This method of resurfacing will prove satisfactory on roads and residential streets where there is not too much steel tired traffic. The cost for a one inch topping will approximate from twenty-five to thirty cents per square yard.

Where the traffic conditions justify resurfacing with material to a depth of two to four inches, I am recommending asphalt macadam penetration methods. From my experience in building successfully many miles of this class of construction I am satisfied it occupies an important place in road work. For the base of this construction I use the old roadbed. Gravel or a soft limestone for a depth of four to six inches after compression may be used. For the wearing surface I use from two to four inches of hard limestone or trap rock depending upon cost, traffic and available material. The stone is graded and applied to obtain the maximum density and mechanical bond of the larger stone which is to carry the load. Refined tar is applied as a paint coat for adhesion and asphaltic cement for cohesion, binder and resiliency, using approximately two gallons to the square yard. The best results cannot be obtained by hand pouring and I recommend the use of pressure distributor for this class of work.

The success of the construction does not depend so much upon the per cent of bitumen used as it does on the uniformity in distribution, the mechanical bond of the stone and the density of the mineral aggregate. The best practice is to screen the stone into four sizes from that passing the two and one-half inch mesh down to dust and apply the different sizes so as to obtain a minimum voidage. To obtain satisfactory results by this method requires the strictest attention to details. It is not unusual to hear of this method of construction being condemned, and of its many failures. I have examined several jobs that have not been successful which cannot be attributed to anything but inexperience on the part of the engineer.

Asphaltic concrete construction, on account of the material entering into it being carefully determined in advance, has proven a satisfactory method of construction, and specifications can be prepared and followed better with this method of construction than with those heretofore spoken of; but owing to the greatly increased cost I believe such construction should be restricted to business streets and on heavily traveled residential streets.

In closing I desire to state that many failures are attributed to the use of bitumen in highway construction but as such a small per cent is used in making up a roadway surface, I believe that most of the failures I have investigated are caused by the lack of experience and attention to the detail with the mineral aggregate of which ninety per cent is in the wearing surface.

The following paper, continuing the discussion, was read by title, Mr. Little being absent.

Discussion Continued by J. C. Little

Chief Engineer, Roland Park, Maryland

I believe that most road engineers will agree that they would rather build a new road, or street, or most any form of construction than to "Resurface an Old Road," but since automobiles have gotten so numerous, we often find ourselves "resurfacing." A great deal of careful study is necessary to determine the best method of procedure in order to get good results at a small unit cost. In the fall of 1908, as City Engineer of the "Ancient City" of Annapolis, I called for bids on the resurfacing of two streets in the residential section of the city, and as the work was entirely new to the local contractors, their bids were too high, ranging from 90c. to $1.05 per square yard, hence were rejected, and the City Engineer was directed to order material and proceed with the work according to the specifi-

cations. The centers of these old roads had been built up from time to time with stone and oyster shells, and were generally firm and hard, except in places, for a width of about twelve feet. Combination concrete curb and gutter was laid on both sides of the street, thus leaving a five-foot space between the old roadbed and the gutter on each side. These spaces were subgraded to a depth of 7 inches below finished grade and filled up with oyster shells, as called for in the specifications, and thoroughly rolled until hard and compact. Any low places in the old roadway were also filled with the shells and rolled.

After this foundation was prepared to a true cross-section two inches below finished grade, about 3 inches of number 2 limestone was uniformly spread from dumping boards and then thoroughly rolled to two inches after compression and finished up, about December 1, in the ordinary way for water-bound macadam, at a total cost of 55.6 cents per square yard, exclusive of the combination concrete curb and gutter.

These two streets were allowed to go over until the following June before any bituminous material was applied to the surface as the weather was too cold at that time to get the proper penetration. Traffic from newly-graded, unimproved streets brought large quantities of mud and dirt on to these streets during the winter and spring, but did not seriously damage them other than the expense of cleaning before applying the surface treatment. Both streets were thoroughly cleaned and given a coat of Tarvia "A", which was applied only on hot days, when, after the Tarvia had been broomed, it was allowed to lay "open" for about two hours before stone screenings were applied, thus obtaining a uniform amount of one-half gallon of Tarvia to the square yard. Stone chips were then spread in just sufficient quantities to take up the tar on the surface, but before rolling, the entire surface was leveled off by the use of the back of an ordinary garden rake, thus obtaining a uniform wearing surface at a cost of ten cents per square yard. Since the completion of these two streets in June, 1909, they have had three other applications of tar, one being applied this year, and both streets are now in good condition.

The writer is of the opinion that the method of construction above described will give better results in the long run, under proper maintenance, than the penetration method where in small towns proper equipment for uniform distribution of the bituminous material is not available, for the cardinal point in resurfacing is unquestionably uniformity, if lasting and smooth surfaces are to be obtained. Of course, in large cities where they have up-to-date asphalt plants of the best type, it is possible to get a uniform wearing surface that will stand up under heavy automobile traffic, but when

these same automobiles cause macadam roads to creep and become so full of humps that they have to be resurfaced, it is a more difficult question.

In the spring of 1911, the writer decided to try a new method of resurfacing. The road was scarified and enough new stone added and then rolled to bring it to a true cross-section, 2 inches below the proposed finished grade. The wearing surface was then applied, being composed of one inch crusher run trap rock, varying in size from one and one-quarter inches down to and including dust, and Mexican asphalt mixed in a Smith concrete mixer, with a self-devised heating arrangement.

The proper quantities for each batch were carefully measured, using 6.5 per cent. by weight of the asphaltic cement. The stone was charged into the mixing device and after it had become thoroughly dry and heated, the asphaltic cement was added at a temperature of 290° to 325° Fahrenheit, and then the mixing continued until each stone was thoroughly coated and the contents of the mixer was a uniform bituminous concrete. It was immediately placed on the road and spread to the proper cross-section and grade, and then rolled with an eight-ton roller until it became compact and hard. Then a squeegee coat of asphaltic cement was applied, and after spreading a uniform coat of fine granolithic screenings over the surface it was rolled and thrown open to traffic. This 2-inch wearing surface with the rather crude plant cost about sixty cents per square yard. Since that time this piece of resurfacing has been watched by a great many persons interested in road construction, and while it has not been subject to extremely heavy traffic, it is in perfect condition to-day, and has not had one cent spent on it for maintenance. This bituminous concrete wearing surface has held up so well that the writer, as Chief Engineer of The Roland Park Company, has not only adopted it as the standard method of resurfacing, but has used it on a concrete base for the past two years on all new construction work in the development. By using two Rapid Heat mixers side by side, the cost of the wearing surface has averaged 45 cents per square yard, we being able to lay 1,000 square yards per day with the two machines.

The bituminous concrete made with too hard an asphalt will be difficult to rake and spread and impossible to compress properly at the temperatures which you can get in the small portable plants. Experience has shown that asphalts having a penetration of from 70° to 85°, give the best results in this climate. In the writer's opinion uniformly good results will never be obtained in bituminous road resurfacing until methods are adopted whereby a uniform mixture of the bituminous material and the mineral aggregate is guaranteed.

CHAIRMAN GASH: The next topic is "Street Pavement." Mr. Hill, City Engineer of Kansas City, Missouri, has a splendid paper. We cannot hear it more than by title. It will be read by title and you can read the paper at your leisure.

Street Pavements

By CURTIS HILL

City Engineer of Kansas City, Mo.

This paper is confined to a brief discussion of the construction and organization features of street paving, excluding that other equally important half of the question, namely, repairs and maintenance.

Kansas City, Missouri, is governed by a Mayor and City Council, with direct supervision of the different classes of municipal affairs delegated to boards, each, if of a constructive nature, with its respective engineering force. Those of a constructive nature are the Fire and Water Board, with all affairs pertaining to fire and water; the Park Board with all parks, parkways and boulevards; and the Board of Public Works, having charge of all other forms of public works affairs such as plumbing, electric lighting, building regulations, trafficways, streets, walks, curbs, sewers, wharfs, flood protection, streams, drainage, bridges, viaducts, etc. The City Engineer is under the Board of Public Works.

An assistant engineer has direct charge of street work, working under whom are the necessary field survey and inspection forces. The testing laboratory is open to all divisions in which the street and other divisions are directly represented.

The standard roadway for streets is prescribed by charter to be 3/5 the entire width between property lines and of the remaining 2/5, 1/5 on each side is for curbing, walk and parking space. These cross sectional widths are varied to suit demands and conditions by special ordinances. The city has approximately 1,200 miles of public streets, exclusive of alleys, parkways and boulevards; 400 of this 1,200 miles are paved and an additional 200 miles are graded. This, within a land area of 58 square miles, is approximately 21 miles of street per square mile of area and also 21 per cent. of the area in streets. For the past four years the city has completed (graded, sidewalked, curbed and paved) about 26 miles annually at a cost of $1,150,000, or $44,200 per mile. The original work is all done by contract under a 5-year guarantee. The average contract prices for the above work are:

Concrete paving, 6 ins.	$1.07 per sq. yd.
Bituminous asphalt, 6-in. base	1.82 per sq. yd.
Bituminous asphalt, resurface	1.57 per sq. yd.
Bituminous asphalt over old brick	1.23 per sq. yd.
Stone block, 8-in. base	3.24 per sq. yd.
Stone block, old base	1.98 per sq. yd.
Brick block, 8-in. base	1.88 per sq. yd.
Creosoted wood block, 8-in. base	2.95 per sq. yd.
Asphaltic macadam, 10-ins. thick	1.22 per sq. yd.

The stone blocks are laid on an 8-in. concrete base of a 1:3:6 mixture of ¼-in. to 2½-in. stone. A 1-in. sand cushion is evenly spread over this base and the blocks set thereon. The blocks are split and straight-edged, 4 to 6 ins. wide, 5 to 6 ins. deep and 8 to 14 ins. long. They are rammed, not rolled, and a cement grout filler used without expansion joints.

Brick blocks are all No. 1 pavers, not to vary more than ⅛ in. from the specified dimensions of 3½ x 4 x 8½ ins., and must pass a round shot rattler test of not to exceed 18 per cent. loss. Either asphalt or cement grout filler is used, with a ½-in. expansion joint every 50 ft. Where the asphalt filler is used it is heated to 350° F. The finished pavement is rolled with a 3- to 5-ton roller.

Creosoted wood blocks are laid upon the same kind of a base as stone or brick. The blocks are 3 ins. wide, 4 ins. deep and 5 to 10 ins. long. They are given an 18-lb. treatment of oil, the product of coal tar without adulteration, gradually applied. The cushion consists of a 1:4 dry mixture of cement and sand not more than 1 in. in depth, sufficient to take up all unevenness of the base and to seal the blocks to it. A 1½-in. expansion joint is provided along each curb and all joints are filled with an asphalt filler. On grades all transverse joints are the thickness of a building lath, the lath remaining in place.

We have such a variation of asphaltic pavements that the general term "asphalt pavement" must always be modified, any of them striking me as a more or less hit or miss proposition. Someone was about right when he said, "Nobody knew what asphalt was and so they called it asphalt cement." In Kansas City we have sheet asphalt, asphaltic concrete, bitulithic asphalt, Topeka asphalt and natural rock asphalt pavements, and are the home of the National asphalt pavement. All except the latter are composed of a bituminous mixture with a mineral aggregate, and all are, or should be, placed on not less than a 6-in. concrete base. The first of these—sheet asphalt—is composed of a binder course 1 in. in thickness of rock, sand and asphaltic cement. Upon this is placed a 2-in wearing surface of a uniform mixture of asphaltic cement, graded mineral aggregate of sand passing different percentages of 6 to 30, through screens from 10 to 200 mesh, and a filler. That referred to above as asphaltic and frequently termed asphaltic concrete, varies from the first or sheet asphalt by varying percentage of

rock aggregate and, by omission of the binder course. The bitulithic and Topeka use rock or gravel in varying percentages over various screens from 2 to 300 mesh, the Topeka using a finer aggregate than the bitulithic. The rock asphalt is a pavement made from the ground rock where it is found naturally impregnated with sufficient bitumen and is the only one not a plant mix. The National Pavement is comparatively new and has yet to prove its worth. It is composed of finely pulverized earth, 75 per cent. passing a 200-mesh screen and is plant-mixed with not less than 16 per cent. of asphalt. The aggregate is earth, loam or clay, finely pulverized, heated to several hundred degrees Fahrenheit to drive out all organic matter and moisture, mixed hot with the asphalt. It is just entering the competitive field, but a small amount has been laid and that 4 ins. thick, without artificial base but directly upon the earth. The original cost of a plant is about $10,000, and the pavement is contracted for about $1.20 per sq. yd. For the short time it has been in use it is showing up very well, although not enough time has elapsed to thoroughly demonstrate its practicability. Samples demonstrated that a temperature of 200° F. does not materially effect it and that it will again combine when crumbled under 300°. It has not been used, in its present form, in Kansas City and if used, I would recommend a concrete base upon the belief that all pavements with a wearing surface should have a rigid, unyielding base.

Of all these asphaltic pavements, sheet asphalt is undoubtedly the best. The asphaltic concrete, bitulithic and Topeka second, are giving good results. The natural rock asphalt must be discarded because of its uncertainty in proportions. In fact, a good asphaltic pavement must be plant mixed. Notwithstanding, Kansas City for several years has laid only the asphaltic concrete, of the asphalt class, specifying it as asphalt pavement. It is laid on a 6-in. concrete base, is 2 ins. in depth, composed of asphaltic cement, graded mineral aggregate and filler, plant-mixed and applied at 135° to 190° C. The asphaltic cement comprises from 6 to 10 per cent. of this wearing surface. The mineral aggregate is clean, sharp mineral particles of a hardness not less than that of good granite and graded over different sized screens ranging from No. 2 to 200-mesh. The filler is a fine mineral, ground to a powder, insoluble in water and composes from 3 to 5 per cent. of the mineral aggregate. A 5-ton roller is used on the finished surface.

Our (Kansas City, Missouri) concrete pavements are laid in one course of 1:2½:4½ proportion, ½-in. to 2-in. stone, to a depth of usually 6 ins. Grade stakes are set transversely every 25 ft. or else the surface is finished to a templet. The

concrete is deposited in strips transverse to the roadway No expansion joints are provided but a cleavage plane, or contraction joint, is placed every 30 ft., composed of one layer of heavy roofing paper which is cut to fit evenly and smoothly with the surface of the pavement. It is finished by hand tamping until the mortar flushes to the surface and is broomed transversely to the roadway with fiber push brooms. Travel is kept off and the surface kept moist for from 4 to 8 days. This is a low cost pavement for residence or equally light traffic streets where the value of property demands a low cost. For this consideration I suggest the use of templets exclusively. It will not materially increase the cost and will give better results. In my opinion, concrete will not wear under heavy or medium heavy city traffic. It has not held here under these conditions although it has not yet received a thorough trial. It is being tried on one of our trafficways where about 3,000 ft. in length and 54 ft. in width of pavement was opened to travel about one year ago. It was laid under special specifications, the best we know how to draw, 8 ins. thick, 1:2:4 mix, and extreme caution and care taken with the aggregate, placing, and in other ways. We gave it a life, under these traffic conditions, of 3 years and present indications are that it will not exceed that. It cost $1.55 per sq. yd. We have about 50 miles of this low cost concrete pavement on light traffic streets, laid during the past four years, where property is not of a high value and the pavement is satisfactory. At the same time, not knowing what the maintenance may be, we are leaving the finished surface everywhere 2 ins. below grade so that it may be surfaced with asphalt. When property can pay for a high grade of pavement, it can pay for asphalt which is more suitable for such conditions. If we draw specifications for a high grade of concrete pavement, take extreme care in construction, reinforce it, etc., thus making a cost equal to that of asphalt, we defeat our own ends.

You all know that no one kind of pavement can be applied to the treatment of all streets alike, owing to topography, traffic conditions, property values, ideas of property holders, higher city officials, etc. But considering Kansas City and similar city conditions it is my opinion that practically three classes of pavements apply.

(A) Where the traffic is very heavy such as in wholesale and freighting sections, granite blocks and some (**not all**) sandstone blocks are suitable on a concrete base of not less than 8 ins.

(B) On medium traffic streets such as the retail sections, creosoted wood blocks or brick blocks with a possible substitution of a small granite block in some places and a granite block on heavy grades, all on not less than an 8-in. concrete base.

(C) For light traffic and residence streets, brick, asphalt and concrete will apply, the brick on those streets of a semi-business class, asphalt in the more valuable residence sections and concrete where a lower cost pavement is applicable. A broken rock of the bituminous bound or oiled (but never simply water bound) type can be added to this class for residence streets only when excellent facilities prevail for a constant maintenance. When properly maintained it is a good residence street.

CHAIRMAN GASH: We have a discussion on this paper by J. M. Owens which will be presented by title and printed in the proceedings.

Discussion by J. M. Owens

Assistant City Engineer, San Francisco

Undoubtedly one of the first things that engages the attention of a traveler upon first entering a city is the condition of its pavements; for over these he must ride to reach any given point, and no matter what else may engage his attention for the time being, the condition of the pavement over which he happens to be traveling soon makes itself apparent to his senses. If the traction is easy he immediately notices the pavement over which he is traveling, and is pleased; if, on the other hand, it is difficult, his resentment is soon evident from his remarks.

What is true in the case of the traveler is more intensely so in the case of the citizen. He is more vitally interested; he pays the costs, and, therefore, he doesn't let anything else lead him away from the subject. He goes out with the express purpose usually of finding fault, and very often he finds it. At best, city pavements are only indifferently good. This condition results from a variety of causes. Amongst these may be mentioned imperfect street laws, having to do with the inception, prosecution and completion of street work; lack of a definite plan of improvement, and a poor selection of paving materials. The other contributory causes are all too well known to merit repetition here. Most of the general problems that affect street improvements in other large American cities obtain here, but, of course, there are exceptions. One of these exceptions, perhaps the most important one with which we have to deal, due to the unusual topography of the site occupied by San Francisco, is that which has to do with grades. I will venture the opinion here that in no other large American city are there such ranges in elevation and such extreme gradients on constructed pavements as obtain here. It will be admitted that 938 feet is an extreme in elevation, and that likewise a constructed pavement

having a gradient of 50.1% is no less an extreme for pavements. The following are some of the pavements laid on extreme grades in this city:

Cobblestone pavement on sand, with gravel filler, on a 50.1 per cent. gradient.

Vitrified paving brick on concrete base and sand cushion, with cement filler, on a 20.7 per cent. gradient.

Asphalt pavement on concrete base, adjoining central strip of basalt blocks, on an 18 per cent. gradient.

I will not take the time to call your further attention to the high elevations existing in this city nor to the steep gradients of its streets, for it is impossible for any visitor to these exposition grounds to even glance to the south and west and not have that fact indelibly impressed upon his mind.

I will, however, call your especial attention to a condition that is not so apparent, namely, that of the settlement of the old filled-in section. You all have traveled over a portion of that on entering the city and traversing Market street from the Embarcadero to Montgomery street. No doubt your first impression was that it was all on solid foundation, and you will be surprised to learn that the annual settlement at its lower end, taken over a period of years, is as much as .10 of a foot per year. Considering the value and extent of the superincumbent improvements, it will be admitted that taking care of such an extreme condition is one of the most difficult problems that the city engineer has to solve.

Unfortunately, we have inherited most of our street grades. A large portion of these are, of necessity, centered in the built-up section, where property values are large and improvements follow the grades, such as they are. Of course, in cases like that, the opportunity for changing or correcting them is almost nil. In extreme cases, however, this has been done, as in the case of the Hayes street cut, but the way is a tedious one and the delays long and frequent. Sometimes such a change will take years to effect.

In the other districts that are partially built up the changing of the grade on any particular street must have the acquiescence of the property owners fronting thereon. In fact, one bull-headed citizen can sometimes block the change for a long time. The intrusion of the property owners, who, of necessity, from lack of technical knowledge, are not capable of always seeing things that are for their own good, is much to be regretted and acts as a great hindrance to obtaining the quickest and best results. Grade changes are usually effected in the following manner: Under petition by the property owners, the city engineer investigates and renders his recommendation to the Board of Public

Works, who act on same. If there are no protests from the property owners, recommendation is made to the Board of Supervisors and final action taken by that board, by passing an ordinance and having same published in the official newspaper for a stated length of time.

In substance the ordinances limiting gradients upon which the different pavements may be laid are as follows:

Asphalt or bituminous rock on gradients up to 6 per cent. in binder district, binder 1½ inches—wearing surface 2 inches.

Asphalt or bituminous rock on gradients up to 8 per cent. in 2-inch wearing surface district.

Asphalt or bituminous rock on gradients up to 8 per cent. in 2½-inch wearing surface district.

Vitrified paving brick, ordinary type, on gradients up to 6 per cent.

Vitrified paving brick, hillside or rough kiln marked variety, on 4-inch base, machine mixed, sand cushion, on any gradient.

Basalt block pavement, on sand foundation, with gravel and asphalt filler, on gradients up to 5 per cent.

Basalt block pavement, on sand foundation, with cement filler, up to 8 per cent. gradients.

Basalt block pavement, on sand foundations, with gravel filler, on any grade.

Basalt block pavement, on concrete foundation, with cement and asphalt filler, on gradients up to 5 per cent.; with cement filler, on gradients up to 8 per cent.; with gravel filler, on any gradients.

Asphalt, with basalt block central strip, on concrete foundation: with gravel and asphalt filler, up to 5 per cent. grades; with cement filler, 5 per cent. to 8 per cent. gradients; with gravel filler, gradients of 8 per cent. and over.

Asphalt, with vitrified brick central strip, on concrete foundation: Ordinary paving brick, up to 6 per cent. gradients; Hillside or special rough kiln marked, 6 per cent. to 18 per cent. gradients.

Cobblestone pavements on gradients of 18 per cent. and up.

Broken rock pavements on any gradient.

I would like to call your special attention to the central strip idea of paving. It is one that we find works out very well for San Francisco conditions. As far as I can learn, it is not in use in many other places. It has been varied in some cases so as to make the asphalt the central strip and the basalt block the side strips. This type of construction has certain advantages; it lessens the cross slope upon a pavement that already has about exceeded the limit in the other direction, and where there is vehicular traffic, it gives the driver a chance to hug the curb and affords a surer foothold for the horse, while it affords the more frequent and rapid motor vehicles an opportunity to traverse the

central smooth portion without being inconvenienced by an excessive cross slope. On Mason street we have such a pavement as I have described, constructed by our street repair department, and it is very satisfactory.

On the boulevards and on the new streets the city engineer's office has been able to gain better results in the way of satisfactory grades than in the cases I have previously mentioned. I think those of you who have ridden over the Junipero Serra and Sloat Boulevards and the recently completed Portola Drive will appreciate this fact; and I would strongly advise those of you who haven't, not to overlook this opportunity of riding over some of the finest stretches of boulevard in the country. Flat crowns have been used throughout, and are being specified on all new work of this kind.

Of equal importance is the subject of alignment. I think that I may safely state that in the early history of San Francisco there was no city plan thought of. Our first knowledge of a street layout is that gleaned from the old records, which state that Juan Vioget, a surveyor, made a survey of San Francisco for the Alcalde F. DeHaro in 1839. This survey covered an area of only six blocks, and was bounded by Montgomery, Sacramento, DuPont and Pacific streets. At various times this was extended, under different officials and commissions, until the city grew into its present shape.

Considering the times and the difficulties under which they worked and their early isolation from the rest of the country, our predecessors established street widths that, in the main, compare favorably with those established in other cities. Of recent years we have made many changes in sidewalk widths. Probably the most extensive change was made in what is known as the 100 Vara District, which is our large wholesale district. These were reduced so as to give a net roadway of 52 feet 6 inches, experience having shown that the original width was inadequate for the toll imposed upon it by the great increase in traffic. In passing I will remark that we have had an experience along those lines that few large cities have had. After the great fire of 1906 and the confusion resulting therefrom, new business centers sprang up and residence streets became business centers; particularly was this noticeable in the case of Van Ness avenue, then the main residence street of the city, which was almost immediately turned into the main business street and remained as such for several years, until conditions readjusted themselves. This imposed an unusual and unforseen amount of wear upon the old asphalt pavement, with the result that it had to be entirely resurfaced from one end to the other. At the present time the character of the traffic

and of the buildings and business is entirely different even from that of the years succeeding the fire. Now it is the great automobile distributing center of the city. What has been said about Van Ness avenue applies also to Golden Gate avenue, which has been transformed from a residence street to an automobile business street. This pavement has been reconstructed twice during the last nine years.

As a considerable portion of our city streets have either been graded to official grade or paved, the problem of improvement usually narrows down to that of the proper selection of a paving material to suit the particular case, with such minor changes of grade, drainage and cross-section as are possible under the ordinances. Only in the case of the opening up of new streets and the selection of boulevard sites has the city engineer's office, through its recommendations to the board of public works and the board of supervisors, a more or less free hand in the planning of suitable grades and the selection of the paving material and design most suitable for the case in hand. This selection is oftimes seriously hampered by the objections of property owners and improvement clubs, who, as I have previously remarked, are, of necessity, not always capable of selecting what will conserve their own or the city's best interests. Too often the idea of cheapness appeals to them rather than that of suitability.

Another frequent cause of failure due to the selection of a cheap type of pavement can be charged to the former law governing street improvements. This law made it obligatory upon the City Engineer to keep the cost of any proposed improvement below one-half of the assessed valuation of any particular lot against which an assessment was to be levied. The large percentage of broken rock and macadam pavements now existing in the outlying districts is due entirely to the existence of such a street law, and the existence of such pavements has helped materially in retarding the advancement of property values in these districts.

Under the new street improvement act of 1913, adopted by the board of supervisors under ordinance No. 2439, on October 29, 1913, briefly described as follows,—"An Ordinance Providing a Method for the Improvement of Public Streets Within the City and County of San Francisco, and the Assessment of the Cost Thereof Upon Private Property and the Payment of Such Assessment in Installments in Certain Cases,"—it is now possible to construct permanent pavements under the 10-year bond plan. This would have been entirely impossible under the old law. Commencing with the adoption of this new street law, street improvements have gone ahead at a rate far in excess of that of any other period in the city's history. In the last fiscal year, 560,104 square

yards of pavements of different kinds were constructed, at a cost of $1,140,630.

Early San Francisco Pavements

Before entering upon the subject of San Francisco's present paving specifications, a foreword concerning the early history of some of its pavements may be of interest. The first type of pavement laid was 3-inch planks and 10-inch stringers, laid on Washington street in 1850. The first official knowledge we have of a permanent pavement, accepted by the city, is in the case of the pavement constructed upon the crossing of Seventh and Harrison streets, which was of basalt blocks and was accepted on April 4, 1861. The intersection of Sutter and Kearny streets, which at present marks the very center of the shopping district, was paved with bitumen and accepted on August 23, 1863. We also learn that asphalt was used with basalt blocks in paving Taylor street, between Pacific street and Broadway, and was accepted on August 6, 1877. When we consider that the modern asphalt pavement was first used on a city street in Newark, N. J., in 1871, we see that San Francisco started early to use good paving materials. From the old records we learn that the "Nicklson Block," the probable predecessor of the modern wood block pavement, was laid here as early as February 26, 1877; that cobblestone pavement was laid in 1862; and that "Carbol Brick" was laid in 1876. Just how these pavements were constructed or what their relative merits were is a matter of conjecture, as there are no reliable records extant. In fact, outside of the bare statement that such streets were graded, planked, macadamized or paved, there is little of value to be gleaned from the early municipal reports.

San Francisco is blessed with a temperate climate and, therefore, its pavements are not subjected to those stresses that are due to extremes in temperature. This makes possible the use of asphalt and bituminous rock pavements on gradients in excess of those upon which this material is laid elsewhere. She is also fortunate in being located centrally in the largest oil and asphalt producing state in the Union. Within a reasonable distance are located some very excellent basalt block quarries, and in the bay counties there are some very fine deposits of rock and gravel suitable for macadam and concrete. Vitrified brick are made from deposits in the county, and are also obtained from the bay counties, but as yet we have no clay deposits that compare with the best in the middle Western and Eastern states. Sand of all kinds is also obtainable, so that it can be readily seen that we have close at hand most of the ingredients necessary to the building of good modern pavements.

Pavements

Of the various kinds of pavements constructed in San Francisco under the jurisdiction of the City Engineer during the last fiscal year, about four-fifths of the total yardage was of asphalt, costing some $839,609.67. This indicates at a glance the rapid increase in favor that this material has gained. Sometime back the natural bituminous sandstone rock was used to an extraordinary extent, but its variable character has given way to the more definite asphalt type of pavement. The older bituminous rock pavements were almost universally made 2½ inches thick and constructed on a 6-inch concrete base. Our present practice is to make the base of 1:2½:7 cement concrete, 6 inches in thickness, although this thickness was exceeded in the case of Lower Market street, where the base was made 9 inches.

On ordinary traffic streets the surface is composed of a 2-inch binder course and a 1½-inch wearing surface. On light traffic streets a 2-inch wearing surface is generally prescribed, and on boulevards a 1½-inch binder course and a 1-inch wearing surface is specified.

Formerly nearly all of our basalt block pavements were laid on a sand foundation, only with a gravel or asphalt and gravel filler, as the case might be. These have proved unsatisfactory, but answered as a temporary expedient on the heavy traffic streets, that happen to lie within the settling district, where they can be relaid occasionally at small expense. What we consider the best type of pavement for use on the heavy traffic streets here is a basalt block pavement, having a 6-inch concrete base, a 2-inch sand cushion and cement grouted joints, which are swept out to a depth of about 1 inch before the grout hardens. The basalt, according to tests that have been made from time to time on it, exceeds granite in those qualities that are generally prescribed for a paving stone. These blocks are dimensioned as follows: 3½ inches to 4 inches in width, 7 inches to 9 inches in length, and 6 inches to 6½ inches in depth, and are required to have no projection or depression exceeding ¼ inch.

Vitrified Brick Pavement

Vitrified brick pavements are in their infancy here. The one that has been constructed the longest, that on Powell street, has the best appearance today, and gives every indication of lasting for a long time. The other brick pavements on the heavy traffic streets, such as on First and Third streets, while in the main in good shape, show signs of wear along the car track and adjoining manhole covers. The rough kiln mark and hillside brick wherever laid have given satisfaction.

Cobblestone Pavement

This pavement is composed of creek bed stones, laid on

edge with the largest dimension upward, on a sand foundation and the joints filled with gravel and the blocks rammed in place. This type of pavement is being rapidly superseded by the vitrified brick pavement.

Summary

To sum up, our experience here in the matter of dimensioning and constructing pavements is very similar to the experience of other cities in that regard, with the exceptions that are always due to the difference in local street laws and local conditions. A few general facts force themselves upon our notice, however. Chief amongst these is the fact that at the present time the highway engineer is not always allowed to use his best judgment in either the location or selection of city pavements, but is hampered by imperfect street laws, local ordinances and by the interference of property owners and others not competent to form a proper opinion in this regard. Another fact is that the future as well as the present traffic needs should be considered, before deciding on the particular kind of pavement that should be constructed in any particular locality. In this regard an increase in the thickness over the usual 6-inch foundation specified should be provided for, as in the case of a district where settlement occurs or where there are unusual and heavy loads to be taken care of.

Our experience here has led us to the belief that the wearing surface should be of less thickness than the binder course. This is not usually specified elsewhere but has given entire satisfaction here.

Another thing that is of unusual importance is the proper construction of a pavement adjoining street railway tracks. The larger part of our pavement troubles comes from imperfect work in this respect. Under existing laws the street railway people are responsible for the construction and maintenance of the pavement over their right of way. This usually extends two feet outside of the track. As this work is usually performed by them either before or after the construction of the rest of the pavement, it is almost impossible to obtain a good job. Every effort should be made to encourage the laying of the concrete base under and adjoining the rails so that the concrete base will be a monolith instead of an arch with a loose keystone in it. With proper attention given to that part of pavement construction, one of the most frequent causes of failure in pavements will be eliminated.

Another fact that is apparent is that a first-class brick pavement should be cement grouted. A plastic filler allows a movement of the blocks and the possible intrusion of moisture into the sand cushion, with a consequent irregularity of pavement resulting. Usually too short a time is specified

for the closing of a concrete base or new brick pavement to traffic. Especially is this the case with brick pavement. If possible, it should be closed to traffic for at least ten days. Another suggestion that I would make is that in the case of an asphalt or bituminous rock pavement, a separate form of gutter, either of brick or basalt block, cement grouted, should be constructed, as this allows of a better handling of the surface drainage by warping the gutters without distorting the cross-section of the pavement surface; and last, but not least, let me insist upon the fact that low crowns should be more encouraged, as the tendency is now to the other extreme, which inevitably results in a poorly designed and unsafe pavement.

CHAIRMAN GASH: This concludes the program this morning. We are hurrying along. Here is a notice of the annual meeting of the American Highway Association, change of time. The annual meeting of the American Highway Association will be held at the Auditorium, Oakland, on Thursday, at twelve o'clock noon, immediately following the adjournment of the regular session of the congress. All members are urged to be present. This is signed by S. E. Bradt, member of the executive committee. Now, remember the program this afternoon. Part of that is special, in addition to the regular program at the Panama-Pacific Exposition, and all should be there promptly.

An invitation has been extended to this congress from the Boston Chamber of Commerce to hold the next session of this congress in Boston. We haven't time to read it, it is in writing and will go into the proceedings. Is there any further business to be brought before this meeting?

MR. COBB: Before we adjourn this morning's session I would suggest that the sessions should be called promptly at the hours scheduled. Now, I believe, we can all get here and we will get along much more rapidly with the business if the sessions are called to order promptly.

CHAIRMAN GASH: I think that is a good suggestion.

MR. COBB: I think the sessions ought to be called to order promptly whether anybody is here or not.

CHAIRMAN GASH: At the future sessions let all the members of the congress be here early so that the meetings can be called to order promptly. This will give a longer time for the discussion of these papers. I know that you all wanted to discuss all these questions more at length this morning, but we have this special program on this afternoon. Don't forget the pleasant part of it, the responses by Mr. Tillson, Mr. Bradt, Mr. MacKenzie and Mr. Hill as announced, in addition to the regular program this afternoon of the Pan-American Road Congress. There will be

a meeting of the American Association of State Highway Officials on Thursday afternoon at three o'clock, room 101, at the Hotel Oakland. The members are requested to be there promptly at that time.

Is there anything further to come before this meeting? If not, this meeting will now stand adjourned to meet promptly at two-thirty at the Panama-Pacific Exposition this afternoon.

An adjournment was then taken to the grounds of the Panama-Pacific Inernational Exposition, Festival Hall, at two-thirty p. m.

FIFTH SESSION, 2:30 P. M.

Festival Hall, Panama-Pacific International Exposition Grounds, San Francisco

JAMES H. MACDONALD: After nearly a week of interesting exercises at Oakland in our Pan-American Road Congress we have been invited to come here today and hold the afternoon session of our congress. We are to enjoy a delightful preface to the occasion. What it is, Director Frank L. Brown will tell you. I take great pleasure in introducing to you Mr. Frank L. Brown, the Director of the Panama-Pacific International Exposition. (Applause.)

Director Brown's Address

Mr. Chairman, Honored Guests and Ladies and Gentlemen: In behalf of President Moore and the board of directors of the Panama-Pacific International Exposition it is my great pleasure and high privilege to welcome this distinguished gathering today. As a matter of history it no doubt will interest you to know that at this exposition the number of congresses and conventions held in commemoration of this event is nearly nine hundred, or more than four times greater than the number of conventions and congresses held at any previous world's exposition, and when you take into consideration the great distance of this city from the centers of dense populations in the East I think it is most remarkable that the attendance here at these conventions has been as large as it has. I think you will agree with me that the occasion for it must have been a comprehesion on the part of the people comprising these congresses and conventions that this exposition commemorates, as it does, the greatest engineering achievement in the history of the world, the completion of the Panama canal, and also an equally great achievement the rebuilding of the city of San Francisco from the most disastrous conflagration of all ages. When you take into consideration the fact that while the United States government was spend-

ing four hundred million dollars in building the Panama canal connecting the two great oceans, and bringing closer together all the nations of the world in friendly accord of trade and commerce and civilization, the people of San Francisco were simultaneously expending a like sum of money, four hundred million dollars, in the rebuilding of their city from that dread conflagration that practically put us out of existence only nine years ago. So this celebration at the Golden Gate, within the walls of the Jewel City, has a deeper note of significance than any previous exposition in the world's history, from the fact that it is the only international exposition ever held that commemorates a living event, the completion of the Panama canal.

Philadelphia celebrated the Centennial, Chicago the Columbian, St. Louis the Louisiana Purchase, and even Portland the Lewis-Clarke Expedition. The previous expositions have been held commemorating past events in the history of the world. This is the first exposition ever commemorating a living event, the first exposition ever held at tide-water, and the first exposition ever held of international importance here on the shores of the Pacific ocean, fronting up on more than one-half of the population of the world, with whom we expect to do business and to live in peace and comity in the centuries yet to come. So that those of us who have been officially identified with the exposition since its beginning have perhaps assumed the situation with a little more seriousness than is generally given because of these vital facts, the rebuilding of our city and the completion of the Panama canal.

Now it has been the custom of our exposition to endeavor to commemorate and celebrate the work of the different congresses and conventions held here. The important papers will be permanently preserved in the archives of the exposition and will constitute an encyclopedia of perhaps the most useful knowledge and the latest evolution in science, in government, in all the material work of the world, as well as in art, literature and religion. Hence it is that we of the exposition welcome here today what we believe is one of the most important congresses that has held its sessions within the Jewel City, and one that is fraught with perhaps more tremendous consequences in the future than almost any other congress. Looking briefly back into the past we realize that about fifty years ago this nation of ours entered into what was known as the steam age. Fifty years ago the building of the railroads was of first and supreme importance. The iron bands were sent out into the trackless wilderness and history will record that the great builders, such as Cornelius Vanderbilt, James J. Hill

and our own C. P. Huntington and his associates were among, not alone the greatest captains of industry, but the great captains of transportation and of civilization as well.

The next evolution or step in the progress and development of this race came twenty-five years later in what is known as the trolley system. Electric roads spanning all of our various towns and cities and connecting whole districts so as to make the country almost as accessible as the city was the next step in the evolution of this nation. The past quarter of a century has been known as the electric age, and now today we are entering upon what I believe history will record as the greatest evolution and development in the progress of this nation or any other nation since the great Roman causeways were built centuries ago, the era of road-building. And when you contemplate its importance and significance and look back over this western coast and consider that when the pioneers first crossed the great prairies and mountain ranges of the west in the old schooners, and when you consider the hardships that they endured, these pioneers of ours, who started this civilization here on the western coast, and then follow it in the next evolutionary stage, the building of trans-continental railroads that cut through the ranges and brought us in closer touch with our brothers of the east, and then the final climax of all achievements, the completion of the Panama canal, the dividing of the land and the uniting of the world, I think it is only right and proper that the next stage, that of good road building, should be brought prominently before the attention not only of this nation, but of the world. I doubt if there is any other way that it could have been done more effectively than by the holding of this great international exposition here on the shores of the Golden Gate and the gathering of your congresses and conventions within our walls, because I have been informed that there has been a steady stream of motor cars across this great continent of ours, while north and south a steady stream of these modern engines of the road have brought the people of the north and the people of the south here to this great exposition. So I think it is not unfair to say that the evolution of good roads will be advantaged at least a quarter of a century by the holding of this exposition here and by the gathering of this great congress of yours on the western coast, because in no other way, I think, could the unthinking public have been brought to a realization that it is possible for a motor car to journey from New York to San Francisco with very little more discomfort than our early trains of about forty years ago. It has seemed to me that the whole of civilization in its next stage of evolution is brought closely into the work that

you people are doing in this building of good roads and in the setting of the example, if I might say, for the other nations of the world. Of course, Europe already has its good roads; but when you consider what Central and South America has yet to accomplish; and when you consider what the other countries of the Pacific have yet to accomplish, I think you will agree with me that your congress and convention here is of exceedingly great importance not alone to this exposition, but the people of all the world as well.

So in accordance with this custom of our exposition we wish to present to the different officials of the different organizations that comprise this great convention our bronze medal. In doing this I ask that you take into account what it typifies and represents perhaps even more than its intrinsic value, because just as the people in Europe have been willing to sacrifice their lives for the Legion of Honor or for the Victoria cross or for the iron cross, these representatives of this exposition in the medals, representing over four centuries of effort on the part of the human race in the building of this civilization here on the western coast, typify and represent the mighty work of the United States government and the people in building the canal; they typify and represent the work and energy and sacrifice of the people of San Francisco in the rebuilding of our city, and last, and perhaps more important, they typify and represent the hope of the future in the lessons learned in this exposition, in art and in learning and in good road building, in engineering and in all the achievements of mankind during the past quarter of a century. So, Mr. Chairman, in behalf of President Moore and the directors of this exposition, I wish to present to Mr. George W. Tillson, president of the American Road Builders' Association, this bronze medal, expressing the gratitude and appreciation of the board of directors of the exposition for the magnificent work you are doing in behalf of the common cause of humanity and of your presence here today. (Applause.)

Response by Geo. W. Tillson

Mr. Director, Ladies and Gentlemen: I must admit that when I was told that it would be my duty to respond to the speech made on the presentation of this medal for the association which I represent, I felt that it was a very pleasant one, not, as some of my friends might say, because I was asked to speak, but because I was surprised and pleased to know that the exposition was taking official notice of our efforts here. When the American Road Builders' Association decided to come to California to co-operate with this meeting we hoped that by coming we would be able to bring some ideas of road building from the East that

would be of some benefit to the road builders of the Pacific coast. We felt that by coming we would gain enough information from the Pacific coast, both technical and non-technical, that would far repay us for any trouble or any expense that we had been put to in this coming. We know now that the second idea was correct; we know now that we have gained enough by this gathering to more than repay us for everything that we have done and for any sacrifices we may have made. I hope that I have been in this California climate long enough, if only for a week, to have imbued myself with that California spirit, that California flow of language, that California peculiar eloquence that will convince a man that what he is saying is true, so that when I go back East to the members of my association who were not able to come out here with us I can tell them and make them believe the wonderful things that we have seen here in this city; the wonderful things that we have seen in traversing this coast,—as I have seen it from the northern line of the United States to the southern,—and that I will be able to make them believe all these things. But if my words will not do this I will have with me some physical thing that will be positive proof that the exposition officials have recognized our efforts and have realized something of what we were attempting to do. So, Mr. Director, in behalf of the Road Builders' Association of America, I wish to thank you most cordially and heartily for this plaque which typifies, as it does, ideas and sentiments so appropriately voiced by you, and to assure you that it will always be kept in the archives of the American Road Builders' Association with a great deal of pride. (Applause.)

DIRECTOR BROWN: This is evidently a wholesale presentation because we have so many distinguished men and so many distinguished associations with us today that we have got a whole flock of medals to present, so you will have to bear with me for a few moments. We have endeavored in all these presentations as much as we possibly could to talk as little shop and to tell you as little of our own exposition business as possible, but I feel that I am not trespassing here upon good nature, nor upon the amenities of life, in telling you that when California undertook the holding of this great exposition the people of all the state put their shoulders back of the enterprise; and when you consider that the citizens of California raised over twenty million dollars for the building of this exposition and that we did not receive a single dollar of money from the United States government, that we have built the buildings and have built the grounds and are now out of debt; also when you consider that simultaneously with raising this twenty

million of dollars for the exposition the people of California at the same time voted eighteen million dollars for the building of good roads (applause) throughout the state of California, and simultaneously voted nine million dollars for the building of the wharves and docks of the city to take care of the ships coming through the canal, I think you will realize that we were very much in earnest and we hope that you will carry back with you the message that we gave to the people of Washington five years ago when we first asked the honor of holding this exposition in behalf of the United States government to celebrate the completion of the Panama canal, and that message was: "The West always makes good." (Applause.) It is now my great privilege to present in behalf of our president and the directors to Mr. Gash, for the American Highway Association this bronze medal, because we want these different associations to know that the people of California have followed the example that you people set and are building the good roads as rapidly as we can. (Applause.)

Response by A. D. Gash

Mr. Director, Ladies and Gentlemen: It gives me pleasure on behalf of the American Highway Association to accept this beautiful medal as an emblem from this great Panama exposition. In the language of Keats, "A thing of beauty is a joy forever, its loveliness increases. It will never pass into nothingness." We are here today in the capacity of road builders of the United States attending the most beautiful exposition that was ever given perhaps in the history of the human family. We are here upon a mission that perhaps is the most important of any that has ever confronted the human family. There is nothing so important to the individual aside from his home and his family as the means of access to the marts of the world, to his place of pleasure and his place of business, and that means of access is known as our highway. We are here advocating in our various capacities the construction of these the most important of our public utilities, the highways of our common country, of the best materials that can be afforded in each community throughout the length and breadth of the land.

The American Highway Association was formed in 1910, I believe, for the purpose of harmonizing principally all of the various road builders' associations in the United States of America. Harmony is the order of the universe, and when you can bring true harmony throughout the length and breadth of the world so that all races of the human family will be in accord with each other, and also when we have good roads throughout the length and breadth of the world, then, indeed, will genuine happiness come

to the human family. (Applause.) Then, indeed, will we become better acquainted, and acquaintance with our fellows makes us think more of them. When you become acquainted with your fellow man you invariably think more of him, and when we all know each other as brothers throughout the length and breadth of the world we will not have then, I apprehend, one-half of the world on fire with the greatest war that was ever going on in history raging on the globe. Then it will be that the swords shall be beaten into plowshares, and the spears into pruning hooks. Then brotherly love, truth and justice will prevail throughout the length and breadth of the world. To encourage better acquaintance and everything conducive to this end, as we road builders believe we are doing, is one of the greatest pursuits men can be engaged in. It is the universal work, the work that fills the spacious earth. It is so great that it leads me into the classics, it leads me to say in the language of Homer:

"Like leaves on trees the race of men is found,
"Now green in youth, now withering on the ground,
"The following spring another race supplies,
"They fall successive and successive rise,
"So generations in their course decay,
"So flourish these when those have passed away;
"But if thou still persist to search my berth
"Then hear a tale, that fills the spacious earth."

The story of man is a story that fills the spacious earth. The story of good roads, the story of highways, is a story that fills the spacious earth, and could all the wealth that is expended for fleets and guns and war equipment and for the tearing down of property and the destruction of human beings by war be expended on the roads, the highways of the world, for a period of one generation, twenty years, that is passing at the present time, every highway on the face of the earth could be builded to every home of stone and be built as smooth and hard as adamant. In the language of Shakespeare, that would be "A consummation devoutly to be wished." But the other is so horrible that it has even impaired the attendance at this great exposition that we are attending here today.

I have no doubt that had the war in Europe not have been going on and could all of the people of the world have turned their eyes to the great Panama exposition that commemorates the building of this greatest of all public highways, the Panama canal, that the attendance at this exposition, although it has been large, would have been doubled, Mr. Chairman. So that it gives us unbounded pleasure to attend this exposition and to hear the words of cheer that were given by the director here today when

he said that this exposition and the Panama canal were built for the future peace and civilization of man. It is a pleasure to be here and on behalf of this organization to accept this medal from this great exposition whose objects are so splendid, and I might say, glorious, if glorious can be applied to the work of man. It gives me particular pleasure, Mr. Director, to accept this medal on behalf of the American Highway Association and to assure you like the former speaker that it will be treasured by them as long as it is an organization, and we hope that will be until every road in the United States is in proper repair and constructed of the proper material. (Applause.)

DIRECTOR BROWN: Mr. Gash's remarks bring with them such a host of memories that I am constrained to say to you that when this awful conflagration in Europe took place our exposition was nearing completion. Some of the weaker-hearted ones wanted us to take the last few dollars that we had left in the treasury and advertise that the exposition was postponed for a year, but after careful deliberation it was decided that as California, in behalf of the United States, had given its word that this exposition would open on February 20, 1915, that we would open on that day if not a single soul came through the turnstiles, because we were determined to keep faith with the people of this nation and the people of the world that had honored us by their presence. So I want you also to bear just this thought in mind, that in the midst of that terrible conflagration in Europe this is the only spot in all the world where all the nations of the world meet in common accord and amity and good fellowship. So perhaps even if the attendance is not half as large as it would otherwise have been this exposition and your presence here today may be an exemplar to the rest of the world, because this exposition has been held successfully in the midst of the greatest disaster of all ages, and the people of the United States have expressed their confidence in California and the directorate as you have done. Hence, is it any wonder that we of the exposition have learned to speak the universal language of gratitude in endeavoring to express the gratitude that we really feel for the people who have helped us put this thing through successfully?

Now, the next association is one filled with peculiarly close and pleasant memories, the Tri-State Good Roads Association. Oregon, Washington and California are the three sister states that in the coming years are destined to play perhaps the most important role in the world's history, and when the Panama canal was completed it made the harbor of Puget Sound, the harbor of San Francisco, of Los Angeles and San Diego the front doors of the nation

instead of the back doors. It is up to the people of the Tri-State Good Roads Association to complete this great work now by linking these three sister states of ours so that the people can drive from the borders of British Columbia down through Washington, Oregon and California, past the most wonderful scenery in the world, and when that has been accomplished I think I can truthfully say that the Pacific coast will indeed become the play garden of the nation. I have seen many people who have made the trip, and have expressed their opinion comparing this coast trip and the best roads in Europe, and while they say, of course, that we have not yet reached the high ideal that some of the European roads have, yet in all that stands for magnificent scenery, in all that stands for comfort and in all that stands for the higher uplift for the human race, these roads on the western coast of America are the best in the world, because there is an utter absence of that povery that is so distressing in some of the older nations of Europe.

I think that we of the western coast, while we bow allegiance to the men of the East for having set us the noble example they have, yet we make that close appeal to our sister states of Oregon and Washington to let us go together, hand in hand, with our faces set hopefully and cheerfully to the future, in order that together we may work out a destiny that awaits these three great states of the Pacific coast. I think I may say that the building of the good roads is the most important factor, indeed, in the advancement of our civilization, our culture and above all our humanity and our service to the world. So, Mr. MacKenzie, it is with the deepest note of gratitude that we of California and of this exposition make our acknowledgments to our sister states of Oregon and Washington for what they have done to help us make good in this exposition, and to unite the three states in that broad span of a highway that will link us together forever. (Presents medal.) (Applause.)

Response by C. L. MacKenzie

Mr. Director, Ladies and Gentlemen of the Pan-American Road Congress: After listening to the eloquent words of the director of the exposition who has so graciously extended to us members of the Tri-State Good Roads Association this tablet of recognition, and to the eloquent words of those gentlemen of the Eastern Highway Associations who are visiting with us at the present time, it has aroused emotions within my breast that if I were an orator I would make a speech to you that I believe would fully represent these Pacific coast states; but I am not a speaker. I extend in a few words the feeling and appreciation that we have for these men of San Francisco, we men of the north, of the

states of Washington and of Oregon, for the great work that they have done for the Pacific coast in the inspiration of the idea, the creation of this exposition, in maintaining it to its present magnitude; and to say to them that all men of the Pacific coast, speaking with a knowledge of my own section, feel proud of their efforts. Their memories will live in the minds of the many thousands who have seen the beauties of this exposition, who have been benefited from its educational advantages, long after the turnstiles have clicked on the last admission and the green sod of the Presidio has come back into its own. They create an exposition greater than that ever created before, and we take it entirely as a tribute to the genius of these men of San Francisco. We of Oregon and Washington were with you in spirit and contributed in a small way financially, but it was due to the indomitable spirit of these men of San Francisco that we must give full credit for the creation, the completion and the management of this beautiful exposition.

To those of us who are here with a mission, so beautifully expressed by Mr. Tillson, this day should be an inspiration and should consecrate us to another year of worthy effort in the furthering of the cause that is so near and dear to all of us, that are doing the best in our ability towards the improving of the highways on the Pacific coast. Speaking as the representative of the Tri-State Good Roads Association, Mr. Director, we accept this tribute with gratitude and thank you. We in our humble way shall endeavor to the best of our ability to be worthy of this emblem you have given us. (Applause.)

DIRECTOR BROWN: This is positively the last one, so take heart. There is an old aphorism out West, and you can all trace its derivation, that whenever you see a man by the name of Hill you always see a big Hill, because ever since Jim Hill placed that great steel highway across the northern part of this continent and united the Great Lakes with Puget Sound we of the West have always had the highest veneration for any man by the name of Hill. I think you will agree with me that it is only fitting and proper that a man of the same name should now be blazing the trail of the big highway from Alaska to Mexico. You can well understand how these men of vision by the name of Hill could see what the future had in store for us. And if we will look back only a matter of a half a century when we first obtained Alaska, and it was called Seward's Folly, and the price he paid, some seven millions of dollars, was regarded as that much money thrown away; when we contemplate that that empire of Alaska is now turning out more gold than any other part of the Union, and when

we discover its wonderful wealth of fisheries and its forests and even its agricultural possibilities, we realize that the same vision that prompted Secretary Seward to obtain Alaska must have prompted Mr. Hill to conceive the idea of the Pacific highway Association!

What a picture! From Alaska's vast mountains of ice to Mexico's sunny clime! What is there left in the world to contemplate when Mr. Hill has accomplished his purpose? We can very well feel, as one old man expressed it, that God Almighty practiced on the rest of the world and then made the Pacific coast just to show what he could do. (Applause.) I wish it were possible to express to you the gratitude that we of the exposition really feel for the men who have devoted years of their lives to this service of humanity, because I can speak feelingly from experience that those of us who have been identified with this exposition for the last five years, have realized that virtue must be its own reward; because it is the only one you are going to get on this earth, and when you find men like your presidents and chairmen here that are willing to give their time, their energies, their money, their brains and their experience to a cause of humanity, and to the betterment of that great word that has crept into the Twentieth Century, "Service," then I think we can truthfully say there is hope for the human race. And the building of good roads that you people have in hand will be the greatest leveler of all differences of human opinions that it is possible to accomplish. If that message of "peace on earth and good will to man" is to prevail, just give us a good highway and a Ford and it is accomplished. (Applause.)

Mr. Hill, I am awfully grateful to you, and the exposition is, for the great undertaking you have in hand; and we know that like your illustrious namesake, "Jim," you will "put it across." (Presents medal.) (Applause.)

Response by Samuel Hill

Mr. Director, Ladies and Gentlemen: It is a great pleasure, Director Brown, to receive at your hands this medal on this occasion, on this day, in this building, in the center of this great exposition. I was pleased when you spoke of the Pacific coast states. It seeemd to me as if you had just got down after all to home folks when you came down to me, because on this coast we like to feel that California, the oldest, the fairest, most beautiful of all our states, has a kindly feeling and casts a kindly eye on Oregon and Washington, her two little sisters on the north.

I wish I might speak today longer, but the director promised you that I should be the last and thereby intimated I should speak only a moment, but I must take just a moment

of your time. Why, I feel that this is, after all, a meeting of only home folks. I look back and I see Mr. Clifford Richardson from New York. I recall how he organized the International Road Congress in Paris where we had brought out the fact that there were three languages to be spoken in our proceedings. I see Mr. Sohier here, and I think of our meeting again at Brussels and in London. I turn and I see Mr. MacDonald, the father of all the good roads men in America. I look down in the audience and I see Mr. Kenyon who sat there with us in the London convention. I see Brother Powers, editor of "Good Roads" Magazine, who has been present at every good roads gathering ever held. Whichever way I turn I am greeted by a kindly face. Mr. Tillson, our distinguished president, who was with us at London; and so all over the world, it has been our good fortune to meet these friends as we do here today, and, thanks to your kind speaker, we feel ourselves at home. What better word is there than all that?

You remember the fact that years ago when the great Leiber, old and feeble and sightless, sat under a tree and they came to hear him speak, saying, "Tell us, then, Sire, what is the most beautiful land in all the world, for you have seen them all, on the shores of India, the gold of the sands, the pearls of Persia, and all the world? Tell us, then, which is the most beautiful land in all the world?" While tears streamed down his cheeks, his hands trembled, his voice shook, he said, "Ah, my friends, only one land in all the world is more beautiful than the others, that is the land where your friends are." (Applause.) So I may well feel happy and proud today, for I can claim friends in every part of this great country of ours.

Now, just one word and I have finished. The director said that we had not yet reached the acme of road building; and he spoke truly, and he intimated what I believe to be true, we never will, but Mr. Director, when you said that we did not have roads in this country that matched the roads of Europe, I turned to my friend and said you would have to make a slight correction because we believe that in these United States there are roads to be found, matched nowhere else in all the world, and I mean that. (Applause.) I bow to Mr. Bowlby, Mr. Tillson, Mr. MacDondald, all these men, and I feel I speak the truth when I say it is no longer necessary to cross the water to find the most beautiful highways in all the world. And you of California, if you please look down toward the highway commissioners that I see sitting before me, and know well that you have here highways that commend themselves to people from all over the world.

Two thousand and thirteen years ago there died in Japan

the great emperor, Timoji Mu, that marvel, because they thought him divine, and as they came together at his bier and paid the last respects in doleful silence one man arose and said, "I will build a temple more grand than the world has ever seen so that people may come here and worship the spirit of our departed emperor." Another man said, "I will build a temple second only to the one described, where people may turn and see it in the memory of our beloved emperor." The third man rose and said, "I know what I will do. I am not so rich or great or powerful as those who have just spoken, but I will build a highway leading to those two shrines and line it with trees which will finally arch over that highway that visitors may walk to the shrine and as they walk there may sit there in the shade of the trees." Two thousand and thirteen years thereafter I found the temples crumbled with decay, but the great highway was there and arched over by the trees still remaining.

So, Mr. Director, I feel you have marked an epoch, have marked a great highway here as long as the world lasts which we will always treasure in memory. This you have done for us and for all, because, after all, my friends, my word to you at the end is the best of all, most characteristic of all of this great state of California, where they demand of their citizens first of all, service, service to California, service to one's country and service to mankind. (Applause.)

CHAIRMAN MACDONALD: We hope the audience will remain with us as we promised to give you a very interesting session in the continuation of the regular work of the congress. Perhaps in all of the discussion which we may have during this great week, there will be no discussion or light shed upon any part of this great movement for highway improvement that so nearly touches the heart and the mind of the people of this country quite so much as the three topics under which this session of the afternoon will be held. The public not only require that which is done in their interest to be well done but they want it honestly done and they want an accounting for every dollar, and so as to satisfy the public in regard to the work placed in the hands of the different officials, the chairman of the program committee, Major Crosby, has carefully gone over everything connected with highway work so that the light of day may be shed upon every part of the official duties placed in the hands of the men who are in charge of the work. And in no part of the work do the public require a greater knowledge or are they inclined to be more suspicious than on this question of accounting, statistics, and supervision of work for which their money is to be expended. With this little introductory I shall be very glad to introduce to you the presiding officer of the afternoon in the discussion of this subject, Judge W.

S. Worden, Treasurer of the Tri-State Good Roads Association.

MR. GASH: He is not present.

CHAIRMAN MAC DONALD: In the absence of Judge Worden we will ask Mr. C. L. MacKenzie, of Washington, who responded so eloquently for the Tri-States Good Roads Association. I take great pleasure in introducing Mr. C. L. MacKenzie. (Applause.)

(C. L. MacKenzie then took the chair.)

CHAIRMAN MAC KENZIE: I am only going to be the chairman, you are going to be the meeting, the whole show. I am simply up here to maintain order and call for the papers as we have them on our program. Before proceeding with the business of the afternoon perhaps some announcements may be in order.

We have the possession of this hall only until five-thirty this afternoon, and it has been suggested that the members then go in a body to the Liberal Arts building. Mr. Welti will be present to discuss the excursion to the points of interest to the delegates in that building. I would say in connection with this excursion to the Liberal Arts building that ordinarily this building closes at six o'clock, but arrangements have been made for keeping the building open until a later hour tonight for the benefit of the party from this convention.

The first paper that we have on the program for this afternoon is a paper on "System in Highway Accounting." The paper is written by Mr. S. D. Gilbert, Auditor of the State Highway Commission of New York. Is Mr. Gilbert present? If he is not present I am going to take the liberty to read his paper as I feel it is a subject in which we are all greatly interested. At least I know the people in my state are vitally interested in this topic, and I think the reading of the paper will be of great interest to you.

System in Highway Accounting

By S. D. GILBERT
Auditor, New York State Highway Commission

Highway accounting is so different from the ordinary business accounting that the system available for the latter cannot be made adaptable for highway purposes. The difficulty lies in the fact that highway accounting has to do entirely with the disbursement of money. This disbursement, if properly analyzed, builds up a source of highway data which is invaluable.

The system that I shall outline is one which is in use in the State Department of Highways of New York, which pays out directly, or indirectly, more than twenty million dollars a year for highway purposes. This system has been

built up and made adaptable to the needs of the department during the past six years, since the department was organized, and has proved itself in both the pleasant and stormy weather which the department has experienced, by furnishing financial data promptly and accurately under sometimes unusual and trying conditions.

There can be no formal rule for highway accounting, but system there must always be. A system of accounting, which may be adaptable to the department of one state, may be absolutely useless to the department of another state, for the reason that the conditions under which departments are organized and obliged to work are different in every state in the Union, occasioned by the differences in the law to which any system must be made amenable. I believe one of the most important questions for the consideration of states spending large amounts for highway purposes is that of a practical uniformity of legislative enactments governing such work and creating the departments under which it is being done. By combining the valuable experience of every state into a comprehensive statute, the benefit of a wider experience in organization would be obtained, and those states just beginning highway work would have the advantage of this. Such uniformity in organization would bring every department into closer relation, and the results would be most beneficial. The collection of national highway data would also be much simplified and made more efficient by such a statute.

A system of practical highway accounting is of much more importance than is generally conceded, for the reason that highway accounting is nothing more nor less than the building of the backbone of highway history. Highway history must have for its foundation highway cost, and every department of highway construction or maintenance is intimately related to it, so that if the accounting is given in such detail and with such a broad view of what is desired to be accomplished, not simply for the present, but for the future, highway history is written each day and may be returned to in the future with the sure knowledge that it will give accurate information with reference to a particular highway long after other incidents of its construction or repair may have been forgotten. There is also the mistake to be avoided, and which is often made, of carrying too much detail in an accounting system, so that it loses flexibility and becomes cumbersome, delaying payments and thereby causing serious and unnecessary criticism of a department. I believe that it is the universal conclusion that where payments are to be made by a municipal or state government, it is expected that they will be long delayed, and yet with the proper system I know of no reason why a municipal or state

government may not make its disbursements as promptly as the most efficient business organization.

The first essential in building up a system of highway accounting is a thorough and comprehensive knowledge of what is to be accomplished, together with a complete understanding of the laws governing the work and its adaptability to them. The assistance of expert accounting knowledge to build the framework of such a system may be used to advantage, but as the system is applied to the work in its operation, if it is to be practical and produce the best results, it must be made adaptable by actual application, and unless it is, it is not possible to estimate the disadvantage. The system must not only meet the requirements of the department, but also must be in unity and work smoothly with the accounting department of the state comptroller, where the final audit is had. Every department will have a large number of live appropriations at one time, from which expenditures are being made, and unless the accounting system of the department is in close relation to that of the comptroller, confusion and error are bound to follow.

The individual highway account should begin with the initial survey and should show the identity of the highway by name or number, preferably both; the county and town wherein located; its length; the type of construction; the date of the contract; the amount, and the contractor's name; if a county road, the percentage to be paid by the state and by the county. As the account progresses it should show the cost of engineering and advertising; amounts paid to the contractor and from what source or appropriation; and when finished, the final distribution of cost between the state, county, town, or city. On account of construction being carried on under contract in most cases, the construction accounting cannot give as much detail of the highway history as the maintenance and repair accounting. The original specification of the highway and the monthly estimates which are paid on it, however, will furnish the information in the detail necessary to complete the construction history.

In maintenance and repair accounting, greater detail can be had and should be required, for the reason that this work is not as uniform as construction and shows a wide variation both as to cost and as to type of work from year to year, so that this branch of accounting should give every possible detail of maintenance work on a highway in order to provide intelligent information in the future. This, of course, must necessarily be based upon the requirements of the department. Some of the subdivisions which should appear in the maintenance accounting of a highway, which are descriptive of the work done, are the following:

Whether the highway is a state or county highway;

Its name and number;
The county and town within which it is located;
A sub-division of disbursements under the headings:
- Improvements;
- Resurfacing;
- Engineering and inspection;
- Ordinary repairs to highway surface;
- Labor or material;
- Cleaning macadam;
- Trimming shoulders;
- Opening ditches;
- Repairs to paving;
- Oil—Cost of spreading and applying—Material for covering;
- Repairs to guard rail;
- Repairs to concrete;
- Tools and plant;
- Patrol, if a patrol system is employed;
- Extraordinary repairs.

To these suggested subdivisions others could be added as found necessary, which will give the desired detail as to the important items of cost, with the result that from year to year a comprehensive analysis of maintenance and repair work is being constructed that not only applies to the whole system, but to the individual road, which is most important.

All construction eventually resolves itself into maintenance and repair, and unless a state continues to make appropriations for construction, construction accounting gradually disappears, and with its disappearance maintenance and repair accounting increases in proportion and remains, as it is not conceivable that a state will abandon its investment in good roads, and it therefore must continue to make appropriations for their maintenance and repair. In order that this maintenance and repair may be carried on economically and intelligently, the work of previous years must be thoroughly reviewed as to the type of work which was done and its cost as related to the individual road, so that the type of work may either be continued from year to year, or changed according to its efficiency. In no other way can this information be obtained except from a properly analyzed and accurately prepared accounting which will give the intelligible information necessary, and which, if it is available, will result in saving the state large amounts of money by avoiding those types of work which have proved themselves inefficient and expensive.

It is extremely easy to get information from the usual accounting as regards the whole situation of disbursements. It could easily be shown that the maintenance and repair of a certain highway for a certain year cost a certain amount

of money, but unless the account has been built up from day to day in the manner suggested above, it will be very difficult at some time in the future to find out just what kind of work was done on the individual highway, what the analysis of its cost is, and whether from this analysis the service received from the type of work indicated warrants its continuation.

It is my experience that the most adaptable method of supporting this suggested accounting is that of voucher payments, so that the voucher representing each individual payment will show the complete distribution of that payment to the different items entering into the account. When the voucher is entered, the distribution is made, and it is completely absorbed, with the result that the account shows the analysis of the disbursements and is supported directly by the voucher in the file.

By using the voucher system a great deal of detail is avoider, and I would strongly advise that the keeping of personal and merchandise accounts should be omitted, as in highway accounting it is not imperative as to how much material has been purchased from a firm or individual, but it is important as to how much the material cost on a certain highway. If the total purchased is desired at any time, it can easily be arrived at from the vouchers in the files, which show all individual payments. By doing this a large amount of useless bookkeeping can be avoided and better results obtained.

In devising a system of accounting it is impossible to foresee the demands which will be made upon it in the future for information and the tests to which it will be put. The only protection, which a department can have, is that the accounting system should be built up from the first with the view of giving the public as complete information as possible and in as great detail as is practicable for the purpose. If this is done, when the test comes it can be met promptly and accurately.

No system can be outlined completely at the beginning, for the reason that the details of the work constantly change, and the system in order to be practical and up to date must change with it and adapt itself to it. By all means avoid ruts. Because certain features of the system were adaptable last year, it does not necessarily follow that they will be this year. Anticipate what the work requires and meet these requirements promptly.

CHAIRMAN MAC KENZIE: Gentlemen, the paper is before you for discussion. The discussion according to our program was to be opened by Mr. A. R. Hirst, state highway engineer of Wisconsin. Is Mr. Hirst present? We shall be

glad to listen to anyone in the discussion of this problem and think it is one of great interest to those who have charge of that particular feature of highway work. Is Mr. Meath present? He is our state treasurer and may have some ideas on that. If there is no one who cares to discuss that question we will take up the next topic, "Uniformity for Highway Statistics and Data." Mr. H. E. Breed, First Deputy Commissioner of the State Highway Department of New York has prepared a paper. Mr. Breed is not present but we have the paper, and it can be read by title and submitted to the secretary as a matter of record unless someone desires that the paper be read.

Uniformity for Highway Statistics and Data

By H. ELTINGE BREED
First Deputy, New York State Commission of Highways

The necessity for uniformity in highway statistics and data cannot be too strongly emphasized. In spite of the fact that much has been written on the subject, it has nevertheless been considered of relatively minor importance not only by the general public, but even by the engineering profession. This may be accounted for by the tremendously rapid development of highways during the past twenty years, which has kept engineers too absorbed in the process and problems of daily construction work to allow them much time for formulation and correlation of a great mass of statistical material. The hour has struck, however, when continued neglect of this important branch of our subject will mean waste of experience, energy and resources. It is hoped that this Pan-American Road Congress may work out some plan according to which important facts shall be recorded to form such statistics and data, as shall be of permanent value to the engineering profession and to all those interested in the constructing and maintaining of highways and the enactment of laws relating to them.

The necessity for uniformity is obvious. Under the present system, many different highway departments are doing similar work without any basis for comparison. The records of one are unintelligible to others. Mistakes made in one department are duplicated by many another. Experiments are repeated, often with unsatisfactory or disastrous results, in a dozen different places. Every department, every engineer, has to learn largely through his own experience, and when this process involves the huge sums now being expended upon highways, it is entirely too costly. Were comparative statistics available, every department would be an experiment station; every experiment station an illumination to the whole field. The conscientious engineer, consulting such statistics upon the inception of any new work could

determine, far more accurately than he can today, factors making for success or failure in it.

Granted the necessity of having a uniform system for keeping statistics and data, we must consider its scope. The speaker believes that it should be broad and comprehensive enough to be of relative worth, without tying itself up into an agglomeration of red-taped detail. Simplicity should be its keynote and motif. It should be devised in such a way as to be intelligible to anyone without the department who came thither for information, and it should give to all employees within the department adequate knowledge of the work; its preliminaries, its progress, and its results. In such a system, only approximate cost data could be sought, for varying local conditions would so change many items as to make them inconclusive.

As it illustrates an attempt to secure such a system, the speaker will describe the method of keeping statistics and data with which he is most familiar—that employed by the Commission of Highways of the State of New York. On July 15 this department had $14,000,000 worth of construction work going on, plus $1,325,000 worth of maintenance work. Its statistical problem, therefore, is large. No attempt has been made to cover the whole field, but for the purposes of this paper this problem has been considered in part under three heads: First, the treatment of maps; second, the tests and tabulation of stone and sand; and, third, the actual highway construction and maintenance data.

The Treatment of Maps

The department has three different styles of maps: A large map of the state shown on a scale of 5 miles to the inch: 57 county maps on a scale of 2 miles to the inch; and aditional county maps made from the United States Government Geological Survey sheets on a scale of approximately 1 mile to the inch. On the large state map projected state highways are shown by two green lines; projected county highways are shown by a single red line; state highways under construction are shown by a black dash line between two green lines; county highways under construction, by a black dash line over a red line; completed state highways by a solid black line and green border, and completed county highways by a plain black line. Finished, this shows the projected state highway system as prescribed by legislative enactment, and county highways as petitioned for and laid out by legislative enactment and county boards of supervisors. In addition to the information given on the large state map, the county maps show, too, the number of contract, its length in miles, the year finished, and the type of construction. The topographical map of each county on the mile-to-the-inch scale gives the same information as the

county map. Each topographical sheet is cut in six sections mounted on linen ⅜ in. apart so that they may be folded for pocket use. When on inspection tours these maps give the essential information at a glance.

Tabulation of Stone and Sand

The large amount of stone and sand that passes through our testing laboratory makes uniformity in the keeping of accurate data essential, in order to avoid duplication of work and to preserve information that will increase economic construction and assist anyone engaged in the building of public highways. In order to handle the work expeditiously and to make it valuable to all the employees of the department, it has been necessary to make a number of comprehensive forms for the correlation of the results of the different tests.

With every specimen of stone submitted for test, the engineer sends with the sample definite information about the location and available supply, giving its exact location on the United States topographical sheet, about the character of rock or material in question, the type of construction for which the same is intended, and the results of any former use. In locating our samples, we have found that the government method of locating by quadrangle is very helpful. By it, each quadrangle is divided into nine sections and these sections are numbered from one to nine inclusive, starting at the upper left-hand corner and numbering across the sheet from west to east. Each section is then divided into equal spaces, lettered from A to V inclusive, from west to east, and numbered from one to thirty-five inclusive, from north to south, the numbers and letters serving as coordinates for the point in this section from which the samples were taken. As nearly as may be roughly determined, the maximum limit of error would be somewhere in the neighborhood of 800 ft., which is practically inappreciable for the work involved. Such an information slip accompanies every stone sample to the laboratory and also accompanies the report of test when the report is made on the specimen. The location of the source from which this sample was taken is then plotted on our office map which shows the highway system, as described above. These maps are very useful, especially in looking up sources of material when we again have construction work in the same vicinity. For all future requirements the record given for this material gives us a service test of the same.

In our stone tests the following determinations are made: Gravity, absorption, coefficient of wear, hardness, and toughness. In order to have a figure which will enable one quickly to compare the relative values of two or more stones, we have a figure which we have designated as a weighted value.

FORM BR-3B 3-2-15-5000 (25-4995)

STONE, GRAVEL AND SAND SAMPLE INFORMATION

STATE OF NEW YORK
COMMISSION OF HIGHWAYS

Division Sample No._____

BUREAU OF TESTS
Albany, N. Y.

_____, N. Y., _____, 191__

Gentlemen:

There has this day been shipped Division Sample No. _____ of _____ taken _____, 191__

SAMPLE taken by _____ (1) _____ from property of _____

Village or City of _____ Town of _____ County of _____

Character of supply is (2) _____ Its location by Index No. is Quad _____ Sec. _____ Letter _____ No. _____

General classification of stone is (3) _____ The available supply is (4) _____

It has been used for (5) _____ Course on Road Nos. _____ The results of its use were

_____

SAMPLE is submitted for use in (5) _____ { Culverts / Course of the (6) _____ Road

Pet. No. _____ Road No. _____ Repair Contract No. _____ Route No. _____ Sec. No. _____ County of _____

From Sta. _____ to Sta. _____ Haul to nearest point on road which is Sta. _____ is _____ miles. Road extends from Sta. _____ to Sta. _____

The kind of stone specified for use on this road for top course is (3) _____ and for bottom course is (3) _____

The type of construction of this road is _____ Binder to be used is _____

Remarks (7) _____

_____

_____

_____

_____

_____

SAMPLE is herewith recommended for use on the (5) _____ course. Signed _____

SEE NOTES ON OTHER SIDE OF THIS FORM.

Engineer Division No. _____

NOTES.

(1.) Give title of person who took sample.

(2.) State whether quarry, ledge, or field stone, or in case of sand or gravel whether bank or creek bed.

(3.) State whether limestone, trap, syenite, etc., etc.

(4.) State whether plentiful or limited. If limited give approximate estimate in cubic yards.

(5.) State whether top, bottom or concrete.

(6.) State name of road.

(7.) Wherever information called for on this form cannot be given, draw a line in the following blank space. Wherever there is insufficient space for information in the form give the additional information under "Remarks," also any information regarding the accessibility of the quarry, character of haul, amount of stripping necessary or other information deemed advisable.

Form BR-1C. 4-22-15-2000 (25-6091)

Results of Stone Tests

STATE OF NEW YORK

Commission of Highways

BUREAU OF TESTS

ALBANY

Filed Under.....

.....

.....

.....

B. R. Sample No. Taken 191 , by Div. Sample No.....

From the property of

Village or City of Town of County of

Location Index No.

Character of supply Cubic yards available

Material has been used on Highways No. Results of use

General classification

Stone specified { Top course @ per cu. yd.
Bottom course @ per cu. yd.

RESULTS OF TESTS

Specific Gravity	Weight lbs per Cubic Foot	Water absorbed lbs. per Cubic Foot	Abrasion		Hardness	Toughness	Weighted Value
			Per cent of Wear	French Co-efficient of Wear			

Type of construction

Remarks

Sample received 191 Tested 191 , by *Engr. in Charge Tests.*

Sample accepted for concrete 191 , by

Sample accepted for course 191 , by

This is obtained as follows: To each of the items, abrasion, hardness and toughness, we affix a weight, giving 3 to the French coefficient of wear (abrasion) as being the most important; assigning 2 to the hardness test as being second in importance and reliability; while to the toughness the weight of 1 is given. These three weighted results are added together, giving the weighted value of the stone tested. All are tabulated on cards for the purpose with the other information mentioned above, as well as the location, owner, available supply, water, where used, etc. Furthermore, these tests are collated on one sheet for each county, listed under headings giving the character of the stone found in the county. The weighted value is placed on our map, it being of great aid when approving or disapproving stone for use from these different localities.

This information of course is not without its limitations. In many instances the chief in the office is unable to judge by the previous information that he has on hand of tests already made, whether sufficient examination has been made on the ground. Often it has been found that a more comprehensive field survey will develop a supply of stone and sand which was not found upon first examination, thus cheapening, in many cases, the cost of construction. And, too, the division by county is rather a rough determination, though it is considered fine enough for the work in hand, as we also take into account the geologic formation when taking action on the various tests.

The results of these tests are reported in duplicate to the division engineer in whose territory the sample was taken. This allows him to preserve in his files a copy of the same and also to transmit a copy to the engineer who is in actual charge of construction. By this means a two-fold purpose is attained, as the data is placed in the hands of the division engineer for his use and future reference, and serves as well to educate the engineer in charge of the work by familiarizing him with the various materials which he employs.

The test for sand is not quite so elaborate as that for stone, but as there is great variation in the supply obtained in many cases, we have provided kits for men in the field which enable them to check the loam determination and also to make some of the mesh analyses. With sands the following determinations are made: Per cent. of loam and its occurrence, that is, whether it occurs in free state or has a tendency to coat the grains; the effect of washing upon the sand; percentage of voids by mesh analysis, using the following sieves: ¼, No. 6, No. 20, No. 50, No. 100 and No. 200. The natural and washed sands are also made up into 2-in. cubes for compression tests, using a standard brand of cement. At the same time we make a compression

specimen, using the same cement and a 20:30 Ottawa sand. The results obtained on the natural and washed sands at the end of 7 and 28 days are compared with results obtained on the specimen made, using the Ottawa sand as a standard, our requirements being that the natural sand, if it is to be used in any of our concrete pavements, shall show a compression at least equal to that of Ottawa sand. It must also be free from organic matter and reasonably free from loam, our specifications stating that 5 per cent. of loam will mean rejection. Sand used for other structures such as culverts, foundations, etc., must show a compression strength of at least 80 per cent. of that obtained with Ottawa sand.

This elaborate detail test of sand may appear to be useless work, but it has been proven by results obtained that in order to have successful concrete pavements, the sand forming the matrix must be as carefully and judiciously selected as the cement that forms a part of the same. Our experience has been that many failures in this type of construction are entirely due to poor sand. Concrete to withstand abrasion and tensile and compressive stresses, is only as strong as the matrix composing it. The inconsistency of present day practice is shown by testing the one important ingredient (cement) with a fine degree of precision, and trusting the other equally important ingredient (sand) to visual guesswork.

Highway Construction and Maintenance Data

As this is one of the most important items for the consideration of uniformity, I shall endeavor to give a description of our system somewhat in detail, chiefly for the purpose of emphasizing the necessity for uniformity and for the keeping of this kind of statistics. Probably every municipality and state engaging in the improvement of highways and pavements has some form or other which covers this class of data, and some effort should be made to reduce the ultimate results to standardized units flexible enough to cover all constructive and maintenance matter and relative enough to permit an intelligible exchange of this data between different departments. These statistics are outlined with the idea of placing in the hands of the designing engineer a rough relative cost of the types of pavement, giving the kind of material used, the density of traffic carried, its growth invited by the improvement, and the life of the pavement, so that he can in the consideration of a new problem, have always before him a service test of magnitude equal to that of the undertaking to be considered. This information should also be of equal value to the maintenance engineer as a record of the results gained from the expenditure of money from year to year on different types, giving him adequate data on which to formulate new kinds of treatment

along lines giving the greatest satisfaction and to discard methods proven by use to be unreliable.

For the purpose of collating this data, the department has adopted three cards, one of which is designed to show all construction data, both general and specific, giving its information in such manner as will be available and intelligible to the general public as well as to the engineer.

General Data.—Under this heading are grouped such general features as highway number, name of highway, etc. In general we have two classes of highways, State highways, built wholly by the State, and county highways, built by the State and county together, for which the State pays from 65 to 85 per cent. of the total cost. In order that they may be distinguished by their numbers, numbers from 1 to 5,000 are used to distinguish county highways, and from 5,000 to 9,000 to distinguish State highways. Those above nine thousand are used for the purpose of designating roads originally constructed by a county or town for which the burden of maintenance has since been assumed by the State.

Our cards are indexed under their highway number and our files are arranged numerically. The name of the highway is generally taken from the city, village or other well known point at each terminus of the road; as for example, Albany-Schenectady Highway. If too long for one contract, it is designated as parts 1, 2, 3, etc. This name system further serves to locate the highway, and, therefore, appears on the card. The length in miles, the name of the county, the route and section number, if a State highway, as well as the petition number, if a county highway, and the length and type in each town and corporation are given to complete the location. The contractor's name and address are also given, as well as the amount of the engineer's estimate, the estimated engineering and advertising charges, and also the amount of the total appropriation with the respective subdivisions of this amount into state, county and corporation charges. The actual cost placed opposite to the foregoing shows at once how carefully the engineers were estimating. Space has also been provided to show the amount spent in agreements, which is the term used for any extra work or change in type. Finally the date of the contract and the date of acceptance complete the general record. This card probably is of value only to the department, and is used most often by the deputy commissioners, the secretary, and the financial bureau.

Specific Data.—The main subdivisions under specific data are widths, materials and costs. Space is provided for three types of pavement, as we often have that number on one road. The length and width of pavement and roadway are shown for each type. Under materials of construction are given the kind and thickness of the foundation, of the bot-

Hwy. No.....Name.....,.....Miles,.....County

Route.....Sec.....Pet. Nos.....

Contractor.....

Address.....

Eng. Est.....Cont. Pr.....

Eng. & Adv._____Spec. Agr._____

Approp.....

State.....Eng.&Adv._____

County.....Total.....

Corp.....State.....

County.....

Prelim. Est. by.....Corp.....

Towns	Miles	Type	Corpor.	Miles	Type

AGREEMENTS

Date	Plus	Minus
Total		

Date of Cont.....Date of Acc.....

Length in Feet	WIDTH		MATERIALS OF CONSTRUCTION								Sq. Yds. of Pavement	Equiv 16 Miles	COSTS				
	Pav.	Rd.	Foundation	Th.	Bottom	Th.	Top	Th.	Binder	Surfacing			Per Sq. Yd. of Pavem't	Per Mile 16′ Pavem't	Exc. per Mi. 26′ Road'wy	Other Items per Mile Cont.	Total Cost per Mile 16′–26′
Item Costs=																	
Final Est. by.....																	
Item Costs=																	

Sq. Yds. of Roadway.....Cu. Yds. Total Excavation.....Cu. Yds. Misc. Foundation.....

Miles Equiv. 26′ Rd. .....Cubic Yds. per Mi. 26′ R'dway.....Cost per Mi. Misc. Found.....

7-26-15-1000 (25-8719)

FORM-B

STATE OF NEW YORK DEPARTMENT OF HIGHWAYS

HIGHWAY CONSTRUCTION & MAINTENANCE DATA

BUREAU OF STATISTICAL RECORD

TYPE BRICK

AGE _____ YEARS.
AGE SHOWN ABOVE IS COMPUTED TO DECEMBER 31ST 19____

A(1) Barber Co.
A(2) Texas Co
A(3) Sun Co.
A(4) Byerley & Sons
A(5) Union Oil Co.
A(6) John Bakes Co.
A(7) Warner-Quinlan Co
A(8) Johns Mansville Co.
A(9) Indian Refining Co
A(10) Standard Oil Co.
A(11) Atlantic Refining Co.
A(12) Amer. Asph. & Rubber Co.
A(13) International Asphalt Co.
A(14) Wadsworth Stone & Paving Co.
A(15) U.S. Asphalt Refining Co.
A(?) Manufacturer Unknown.
T(1) United Gas Improv. Co.
T(2) Barrett Mfg. Co.
G Granite
D Dolomite
L Limestone.
S Sandstone.
Scr. Screenings
Gr. Gravel
Gn. Gneiss
Sy. Syenite
Tr. Trap
Q. Quartzite

TOTAL MILEAGE	MILEAGE OF TYPE	HIGHWAY NUMBER	MATERIAL							UNIT COST PER MILE					COST OF PAVEMENT PER SQ.YD.	COST OF TOP COURSE PER SQ.YD.	COST OF MAINTENANCE PER YEAR					AVERAGE TRAFFIC TONNAGE PER DAY		DATE COMPLETED	REMARKS
			BOTTOM		MIDDLE		TOP		BINDER	PAVEMENT ALONE	OTHER CONTRACT ITEMS	ENGINEERING WHOLE ROAD	TOTAL WHOLE ROAD	EQUIVALENT FOR 16 ROAD PAVEMENT ALONE			FIRST YEAR	SECOND YEAR	TOTAL TO DATE	PER MI. PER YEAR	PER SQ.YD. PER YEAR	BEFORE IMPROVEMENT	AFTER IMPROVEMENT		
			KIND	THICK	KIND	THICK	KIND	THICK																	
1.00	1.00	240	CON.	6			BB.	4		19820	2600	530	32950	20650	2.2000	1.4050	1743	----	1743	290	.0322	NO CENSUS		1-27-08	AGE 6
0.47	0.47	787	"	5			"	4		14380	210	1590	16180	18120	1.9300	----	----	----	----	000	.0000	"	"	3-11-11	" 3
1.06	1.06	853	"	5			"	4		16260	5920	1240	23420	18580	1.9790	----	87	----	87	30	.0033	"	"	12-22-10	" 3
1.70	1.70	857	"	5			"	4		18790	1430	1870	22090	18790	1.9000	----	140	989	2124	500	.0520	"	"	9-10-11	" 2.5
0.97	0.97	862	"	5			"	4		31070	14220	2590	50880	18930	2.0170	----	58	----	58	25	.0014	"	"	9-9-11	" 2.5
1.89	1.89	5019	"	5			"	4		16470	2300	1580	20350	16470	1.7550	1.0050	311	348	659	120	.0124	"	"	11-10-10	" 3
1.06	1.06	5067	"	5			"	4		31960	10660	2210	44830	15960	1.7000	.9500	154	----	154	60	.0031	"	"	6-28-11	" 2.5
7.08	7.08	751	"	5			"	4		22690	1290	1040	25020	22690	2.4180	----	25	582	2084	150	.0157	"	"	9-4-12	" 2
2.01	2.01	866	"	5			"	4		21620	690	1410	23720	21620	2.3040	----	470	274	744	190	.0197	"	"	1-8-12	" 2
2.30	2.30	916	"	5			"	4		18110	5040	1340	24490	18110	1.9280	1.2670	----	----	----	000	.0000	"	"	1-8-12	" 2
0.65	0.65	5052	"				"			25790	5690	4590	36070	18300	1.9500	----	329	----	329	250	.0191	"	"	APR. 12	" 2
1.08	1.08	5161	"	5			"	4		27520	2520	2310	33350	16935	1.8040	1.0540	----	----	----	70	.0046	"	"		" 2
2.30	2.30	5063	"	5			"	4		18140	3450	1960	23550	18450	1.9660	----	----	----	2365	570	.0512	"	"	11-1-11	" 2
0.36	0.36	5099	"	5			"	4		25580	10820	4230	40630	16880	1.7980	1.0800	243	----	243	340	.0238	"	"	12-31-11	" 2
3.63	3.63	914	"	5.25			"	4		19630	2690	1290	23610	19630	2.0910	1.2590	472	676	1148	210	.0225	"	"	9-4-12	" 1.5
4.11	4.11	917	"	5.5			"	4		19170	3160	1540	23870	19170	2.0410	1.2810	177	----	177	30	.0031	"	"	1-18-13	" 1.5
2.25	2.25	989	"	5			"	4		28140	12240	1790	42170	18200	1.9390	1.1000	----	----	----	000	.0000	"	"	1-20-13	" 1
1.03	1.03	990	"	5			"	4		26760	5585	2525	24860	18260	1.9450	1.2430	----	----	----	000	.0000	"	"	1-8-13	" 1
0.51	0.51	1049	"	5			"	4		51300	23710	1250	76260	19870	2.1170	1.7000	----	----	----	000	.0000	"	"	2-1-13	" 1
1.27	1.27	5132	"	5			"	4		32040	4100	1800	27940	19340	2.0720	1.2440	16	----	16	10	.0008	"	"	DEC. 12	" 1
2.84	2.84	5193	"	5			"	4		19230	4660	770	24660	19230	2.0490	1.1780	----	----	----	000	.0000	"	"	12-1-12	" 1
2.15	2.15	759	"	5			"	4		18620	4240	2050	24910	18620	1.9800	1.3800	641	----	641	600	.0636	"	"	7-1-13	" .5
3.69	3.69	5164	"	5			"	4		21560	3290	1310	26160	21560	2.2856	1.50	156	----	156	800	.0089	"	"	10-1-13	" .5
2.92	2.92	5172	"	5			"	4		17530	9580	1880	27990	17530	1.8570	1.2600	----	----	----	85	.0090	"	"		" .5
1.48	1.48	5201	"	5			"	4		24500	12490	3270	40260	18160	1.9350	1.2580	----	----	----	000	.0000	"	"	12-1-13	"
1.54	1.54	5206	"	5			"	4		21070	5550	1520	28140	18400	1.9600	1.3000	----	----	----	000	.0000	"	"	11-1-13	

FORM-B

STATE OF NEW YORK DEPARTMENT OF HIGHWAYS

HIGHWAY CONSTRUCTION & MAINTENANCE DATA

BUREAU OF STATISTICAL RECORD

TYPE BITUMINOUS

AGE 3½ & 4 YEARS
AGE SHOWN ABOVE IS COMPUTED TO DECEMBER 31ST 19..

A(1) Barbee Co.
A(2) Texas Co
A(3) Sun Co
A(4) Overley & Sons
A(5) Union Oil Co
A(6) John Dakes Co
A(7) Warner-Quinlan Co
A(8) Johns Mansville Co
A(9) Indian Refining Co
A(10) Standard Oil Co
A(11) Atlantic Refining Co
A(12) Amer. Asph. & Rubber Co
A(13) International Asphalt Co
A(14) Wadsworth Stone & Paving Co.
A(15) U.S. Asphalt Refining Co
A(?) Manufacturer Unknown
T(1) United Gas Improv. Co.
T(2) Barrett Mfg. Co
6 Granite
D Dolomite
L Limestone
S Sandstone
Scr. Screenings.
Gr. Gravel
Gn Gneiss
Sy Syenite
Tr. Trap.
Q Quartzite

TOTAL MILEAGE	MILEAGE OF TYPE	HIGHWAY NUMBER	MATERIAL							UNIT COST PER MILE					COST OF MAINTENANCE PER YEAR					AVERAGE TRAFFIC TONNAGE PER DAY		DATE COMPLETED	REMARKS
			BOTTOM		MIDDLE		TOP		BINDER	PAVEMENT ALONE	OTHER CONTRACT ITEMS	ENGINEERING WHOLE ROAD	TOTAL WHOLE ROAD	EQUIVALENT FOR 16' ROAD PAVEMENT ALONE	COST OF PAVEMENT PER SQ.YD	COST OF TOP COURSE PER SQ.YD	FIRST YEAR	SECOND YEAR	TOTAL TO DATE	PER MI. PER YEAR	PER SQ.YD PER YEAR	BEFORE IMPROVEMENT	AFTER IMPROVEMENT		
			KIND	THICK	KIND	THICK	KIND	THICK																
2.87	2.87	347	AP.	3			AP.	3	GENASCO	7610	3330	1660	12600	8800	.9380	.6670	12	1088	6612	575	.0710		386	1-1-10	
5.74	5.74	412	"	3			"	3		6680	5650	1120	13450	7650	.8140	.5899	459	896	2696	135	.0164		644	9-13-10	
3.27	3.27	413	"	3			"	3		7255	4205	1575	13035	8250	.8794	.6294	1447	292	2828	215	.0262	NO CENSUS		10-11-09	
4.19	4.19	423	"	4			L.	2		8570	2850	1200	12620	11030	1.1750	.6310	638	536	7470	450	.0610	"	"	1-4-10	
5.40	5.40	440	F.B.	8			GN.	3		6910	2470	900	10280	9170	.9770	.5870	573	490	3563	170	.0233		224	1-15-10	
4.44	4.44	489	LOC.	4			L.	2		5605	3910	1095	10610	7275	.7749	.4082	699	628	3060	170	.0238		310	11-20-09	
6.43	6.43	547	TRAP	3			TRAP	3		10700	2235	1275	14210	10700	1.1200	.7650	259	4518	5694	250	.0266		614	11-22-10	
3.87	3.87	562	LOC.	3			SY.	3		10510	3950	1130	15590	9610	1.0240	.6990	615	538	2995	170	.0163		505	1-4-10	
5.02	5.02	564	L.	4	TRAP OR SY.	2				8080	2940	1050	12070	8080	.9020	.5470	585	670	2759	125	.0130		833	1-6-10	
4.25	4.25	585	AP.	3			AP.	3		6820	4480	1490	13190	7830	.8340	.5760	602	640	4754	280	.0342		428	12-16-09	
3.88	3.88	604	"	3			"	3		8530	1890	1670	12090	8530	.9090	.2420	1023	759	4289	270	.0276		1084	2-5-10	
2.24	2.24	630	"	3			"	3		7800	3210	1940	13950	8800	.9380	.6670	678	592	3379	380	.0402	NO CENSUS		1-4-10	
1.01	1.01	638	L.	4			L.	2		7980	2590	1930	12300	9910	.9600	.5100	99	228	327	90	.0110		1254	11-12-10	
4.12	4.12	646	AP.	3			AP.	3	A-1-A	8020	4240	1510	13760	8010	.8830	.6110	108	282	1481	90	.0096		262	5-28-10	
5.66	5.66	650	LOC.	3			L.	3	A-1-GEN.	9850	4770	1200	15820	9135	.9730	.6870	257	1876	8361	420	.0417	NO CENSUS		8-26-10	
5.35	5.35	654	"	4			SY.	3	TEXAS	9510	3220	1320	14050	10720	1.1420	.7640	430	1351	3395	150	.0179	"	"	8-1-10	
4.25	4.25	690	AP.	3			TRAP	3		6475	3025	1420	10920	7560	.8060	.5980	509	403	7239	450	.0530		264	6-22-10	
5.56	5.56	719	"	3	AP.	3	AP.	2		7665	3355	1080	12100	8160	.8690	.4200	1368	843	2934	150	.0161		452	9-24-10	
5.46	5.46	745	"	3			"	3		8360	3750	1060	13170	9250	.9850	.6790	567	696	3163	130	.0152		497	1-22-09	
5.91	5.91	747	LOC.	4			TRAP	2		10170	4750	780	15700	10170	1.0830	.7500	2326	1980	9079	380	.0409		290	2-16-09	
10.14	10.14	794	AP.	3			"	3		10660	1560	730	12950	10550	1.1240	.7490	2911	5405	13317	380	.0395		4848	9-22-10	
6.20	6.20	795	"	3			AP.	3		5940	6030	1395	13365	6775	.7220	.5140	718	1789	3656	150	.0174		512	7-19-10	
4.62	4.62	796	"	3			"	3		7370	3780	1280	12430	7370	.7850	.5600	2257	2696	8244	450	.0475		275	12-16-09	
1.00	1.00	808	L.	3			TRAP	3		13160	5490	1990	20640	10720	1.1420	.8840	8	----	8	2	.0002	NO CENSUS		2-23-09	
.70	.70	809	L.	3			L.	3		10330	6070	2080	18480	8355	.8900	.6190	----	----	----	000	.0000		408	11-20-09	
4.45	4.45	841	AP.	4			AP.	2		6610	5740	1340	13690	6610	.7040	.4300	596	712	2499	190	.0200	NO CENSUS		1-10-11	

FORM-B

STATE OF NEW YORK DEPARTMENT OF HIGHWAYS

HIGHWAY CONSTRUCTION & MAINTENANCE DATA

BUREAU OF STATISTICAL RECORD

TYPE WATERBOUND

AGE _____ YEARS
AGE SHOWN ABOVE IS COMPUTED TO DECEMBER 31 OF 19

A(1) Barber Co
A(2) Texas Co
A(3) Sun Co
A(4) Beverley & Sons
A(5) Union Oil Co
A(6) John Baker Co
A(7) Warner-Quinlan Co
A(8) Johns Manville Co
A(9) Indian Refining Co
A(10) Standard Oil Co
A(11) Atlantic Refining Co
A(12) Amer Asph & Rubber Co
A(13) International Asphalt Co.
A(14) Wadsworth Stone & Paving Co
A(15) U.S Asphalt Refining Co
A(17) Manufacturer Unknown
T(1) United Gas Improv Co
T(2) Barrett Mfg: Co
G Granite
D Dolomite
L Limestone
S Sandstone
Scr Screenings
T Trap
Gr Gravel
Gn Gneiss
Sy Syenite
Q Quartzite

TOTAL MILEAGE	MILEAGE OF TYPE	HIGHWAY NUMBER	MATERIAL: BOTTOM KIND	BOTTOM THICK	MIDDLE KIND	MIDDLE THICK	TOP KIND	TOP THICK	BINDER	UNIT COST PER MILE: PAVEMENT ALONE	OTHER CONTRACT ITEMS	ENGINEERING WHOLE ROAD	TOTAL WHOLE ROAD	EQUIVALENT FOR 16 ROAD PAVEMENT ALONE	COST OF PAVEMENT PER SQ YD	COST OF TOP COURSE PER SQ YD	COST OF MAINTENANCE PER YEAR: FIRST YEAR	SECOND YEAR	TOTAL TO DATE	PER MI. PER YEAR	PER SQ YD PER YEAR	AVERAGE TRAFFIC TONNAGE PER DAY: BEFORE IMPROVEMENT	AFTER IMPROVEMENT	DATE COMPLETED	REMARKS
2.00	1.50	1	L.	4			TRAP	2		---	---	960	8260	----	----	---	2681	15349	29100	970	.1033	NO CENSUS		DEC.98	AGE 15
1.00	0.15	10	"	4			"	2		3520	2490	1430	7440	3760	.4000	.2000	640	900	7907	560	.0642		931	JAN.00	" 14
1.03	1.03	11	"	4			"	2	L. SCR.	---	---	2200	10330	---	----	----	832	53	4800	360	.0407		427	JAN.01	" 13
2.60	2.60	13	"	4			"	2	" "	----	----	920	8040	----	----	----	10869	1357	21956	650	.0667		716	SEP.00	" 13
1.11	1.11	14	GN.	4			"	2	" "	4400	1810	940	7150	4700	.5010	.1860	539	----	2892	210	.0237		831	SPG.01	" 12.5
0.63	0.63	15	L.	4			"	2	" "	----	----	1020	11500	----	----	----	2	542	6963	820	.0862		265	6-22-00	" 13.5
5.66	5.66	16	BLUE	3			BLUE	3		2880	1900	530	5310	3830	.4080	.2040	NO RECORD		40461	550	.0779	NO CENSUS		NOV.00	" 13
0.60	0.60	17	AP.	4			TRAP	2	" "	6010	2960	1360	10320	5970	.6364	.3184	" "		4610	640	.0678	"	"	SEP.01	" 12
3.06	3.06	18	"	4			"	2	" "	6270	1730	950	8950	6275	.6685	.3275	" "		22530	610	.0654		1293	DEC.01	" 12
2.79	2.79	19	"	4			"	2	" "	5280	3300	1460	10040	5280	.5625	.2745	" "		22828	650	.0697		1442	SEP.01	" 12.5
1.45	1.45	23	L.	4			"	2	" "	----	----	630	11970	----	----	----	4188	1216	8835	470	.0399	NO CENSUS		NOV.00	" 13
3.05	1.35	25	LOC.	3			LOC.	3	LOC.SCR.	6420	2190	840	9450	6860	.7310	.4180	253	2771	33648	1000	.1141		895	JAN.03	" 11
2.59	2.59	26	AP.	4			TRAP	2	L. "	5580	2240	930	8750	5580	.5931	.3153	NO RECORD		7232	240	.0258		227	SEP.02	" 11.5
3.41	3.41	28	"	4			"	2	" "	------	----	960	10700	----	----	----	4296	9326	22216	540	.0579		667	APR.02	" 12
1.06	1.06	29	S.	4			"	2	" "	----	----	910	11310	----	------	------	578	1589	4144	325	.0347		768	" 02	" 12
5.72	5.72	31	BLUE	4			BLUE	2		4210	2350	740	7300	5160	.5500	.1730	NO RECORD		20772	330	.0431		458	NOV.02	" 11
2.16	2.16	34	LOC.	4			TRAP	2	" "	5780	2990	930	9700	5770	.6152	.3000	" "		19208	740	.0788		1490	DEC.01	" 12
0.47	0.47	40	L.	4			L.	2	" "	-----	----	830	8110	-----	----	----	49	2895	3491	675	.0719		944	AUG.02	" 11
2.74	2.74	41	"	3			"	3	" "	5325	2119	752	8196	5680	.6050	.3580	925	3182	23016	750	.0830		1450	7-1-02	" 11.5
1.75	1.75	47	LOC.	4			"	2	------	------	----	640	9770	------	------	------	NO RECORD		10254	490	.0520		1016	MAY. 02	" 12
3.69	3.69	52	"	3			LOC.	3	LOC.SCR.	4390	2190	1230	8510	5880	.6264	.3132	" "		39789	930	.1337		1423	JL.02	" 11.5
1.76	1.76	53	"	4			"	2	" "	4540	2650	750	7940	6060	.6459	.2367	" "		9947	490	.0694		634	AUG.02	" 11.5
2.65	2.65	54	"	3			"	3	L. "	4390	3200	920	8510	5850	.6230	.3115	" "		13181	450	.0642		732	NOV.02	" 11
1.00	1.00	57	L.	3			L.	3	" "	6670	1200	910	7780	5660	.6030	3010	74	----	2902	260	.0281	NO CENSUS		OCT.02	" 11
3.04	3.04	60	"	4			TRAP	2	" "	------	----	980	11640	----	-----	------	2074	8160	19047	540	.0581		810	JUN.02	" 11.5
1.30	1.30	61	"	4			"	2	" "	------	----	1270	11390	----	-----	------	1676	336	4953	320	.0337		379	NOV.01	" 12

FORM-B

STATE OF NEW YORK DEPARTMENT OF HIGHWAYS

HIGHWAY CONSTRUCTION & MAINTENANCE DATA

BUREAU OF STATISTICAL RECORD

TYPE MISCELLANEOUS

AGE _____ YEARS.
AGE SHOWN ABOVE IS COMPUTED TO DECEMBER 31ST 19__

A(1) Barber Co
A(2) Texas Co
A(3) Sun Co
A(4) Overley & Sons
A(5) Union Oil Co
A(6) John Baker Co
A(7) Warner-Quinlan Co
A(8) Johns Manbville Co
A(9) Indian Refining Co
A(10) Standard Oil Co
A(11) Atlantic Refining Co
A(12) Amer. Asph. & Rubber Co.
A(13) International Asphalt Co.
A(14) Wadsworth Stone & Paving Co.
A(15) U.S. Asphalt Refining Co
A(?) Manufacturers Unknown.
T(1) United Gas Improv. Co
T(2) Barrett Mfg. Co
G Granite.
D Dolomite
LS Limestone
Sst Sandstone
Scr Screenings.
Gr. Gravel
Gn. Gneiss
Sy. Syenite.
Tr. Trap
Q Quartzite

TOTAL MILEAGE	MILEAGE OF TYPE	HIGHWAY NUMBER	MATERIAL: BOTTOM KIND	BOTTOM THICK	MIDDLE KIND	MIDDLE THICK	TOP KIND	TOP THICK	BINDER	UNIT COST PER MILE: PAVEMENT ALONE	OTHER CONTRACT ITEMS	ENGINEERING WHOLE ROAD	TOTAL WHOLE ROAD	EQUIVALENT FOR 16' ROAD PAVEMENT ALONE	COST OF PAVEMENT PER SQ.YD.	COST OF TOP COURSE PER SQ.YD.	COST OF MAINTENANCE PER YEAR: FIRST YEAR	SECOND YEAR	TOTAL TO DATE	PER MI. PER YEAR	PER SQ.YD. PER YEAR	AVERAGE TRAFFIC TONNAGE PER DAY: BEFORE IMPROVEMENT	AFTER IMPROVEMENT	DATE COMPLETED	REMARKS
0.90	0.10	864	CON.	5			MED. BLK.			13720	10770	1750	26350	23840	2.5400	———	1015	———	1015	565	.0423	NO CENSUS		1-24-12	AGE 2
1.99	0.69	870	"	5			BIT.	2		16700	9850	1710	28260	18730	1.9950	———	207	———	207	50	.0044	"	"	1-24-12	" 2
0.46	0.23	956	"	5			G. BLK.	5		19920	8360	4150	32430	30980	3.3000	2.5500	———	———	———	000	.0000	"	"	10-27-13	" 0
3.10	0.07	1047	"	5			MED. BLK.			25870	16555	1405	43830	24775	2.6390	2.0000	183	———	183	60	.0031	"	"	1-22-13	" 1
3.56	2.35	5008	"	4			L.	3	A-3AA	10210	3750	1080	15040	12590	1.3206	.8726	1040	2643	3683	520	.0544	"	"	12-30-11	" 2
3.73	0.20	5028	"	5			W.BLK.	4		———	———	2610	36000	———	———	———	637	742	1379	185	.0141	"	"	1-31-12	" 2
1.53	0.05	5040	"	6			G.	7		28400	3850	2090	33340	20450	2.1790	———	339	———	339	70	.0044	"	"	12-13-10	" 3
2.01	0.95	5058	GR.	4			GR.	2	A3 A-T-1	24690	320	2410	30300	———	———	———	652	———	652	130	.0101	"	"	1-31-12	" 2
3.41	0.05	5100	CON.	5			MED. BL.	7		22170	6090	1620	29880	29175	3.1080	2.5600	733	———	733	215	.0163	"	"	1-8-13	" 1
5.31	0.57	5110	GR.	3			GR.	3	A-10-A	6480	3120	1203	10830	5865	.6250	.4560	575	———	575	220	.0229	"	"	6-3-13	" .5
1.20	0.75	5131	CON.	5			BITU.	—	A-3-A	26280	10890	1880	39050	21075	2.2450	———	69	———	69	60	.0042	"	"	1-8-13	" 1
0.17	0.07	5159	"	5			W.BLK.			20190	15980	390	36560	39430	4.2000	———	78	———	78	230	.0241	"	"	DEC.11	" 2
5.22	2.68	5231	GR.	6			GR.	2	A-1-A-AA	9130	1650	910	11690	7980	.8500	———	994	———	994	190	.0180	"	"	12-27-12	" 1
10.67	0.10	5382	CON.	5			MED. BLK.			9440	4895	965	15300	27450	2.9240	2.2500	———	———	———	000	.0000	"	"	12-29-13	" 0
10.67	9.67	5382	MASSAM CON.	4.5			SCR.		TARVIA-A A-10-H.D.	9440	4895	965	15300	7960	.8480	.0960	———	———	———	000	.0000	"	"	12-29-13	" 0
1.32	1.32	5299	GR.	4			BIT. GR	2.5	A-1-A	26220	10175	860	37250	14325	1.5260	1.0250	———	———	———	000	.0000	"	"	7-8-14	" 1
6.87	0.86	5365	CON	4.5			SCR.	.5	A-1-A A-1-A	10100	4450	860	15410	9537	1.0160	.1660	———	———	———	000	.0000	"	"	11-13-13	" 0
5.67	5.67	538	"	5			SH. ASPH.			14225	2190	1220	18270	14370	1.5300	1.0500	1172	———	1172	100	.0110	"	"	1-8-13	" 2
7.00	7.00	5250	"	4.5	HASSAM					7770	5360	700	13830	7770	.8120	———	———	———	———	000	.0000	"	"	11-6-13	" 0
2.45	2.45	5380	GR.	5			CON.	4.5	HASSAM TAR SURF.	12080	2520	1330	15930	11750	1.2510	.9870	———	———	———	000	.0000	"	"	11-13-13	" 0

tom and top courses and of binder and surfacing used. Under foundation will appear such forms of construction as telford, sub-base, etc. Binder will show water for water bound; asphalt and tar for bituminous; grout for brick roads, etc. Surfacing includes wearing course and oil, tar or glutrin treatment, etc. Costs are figured on the per yard and per mile basis, using 16 ft. of pavement and 26 ft. of roadway as the standard in width. The reason for the adoption of these widths is that they are the most general type in use in New York.

As the width of pavement many times varies from 12 to 50 ft. where the width of roadway varies from 24 to 50 ft., on account of improvements mainly in villages and cities, the necessity for the above standard for comparison is obvious. Both preliminary and final estimates are shown. The square yards of mileage in a 26-ft. roadway are given as a basis for computing cost of excavation. A total excavation in cubic yards and the number of cubic yards per mile of 26-ft. roadway are given to show whether the excavation was light or heavy. The number of cubic yards for miscellaneous foundation and its cost per mile are given to show the amounts of extra foundation course that are required owing to bad soil conditions. These specific data are of great value in properly forecasting future work and if a system for uniformity can be devised, much may be learned through them of benefit to others engaged in highway work.

Data Sheets.—In order that the commissioner, deputy commissioners, division engineers and other employees may have reliable data, so as readily to compare different highways under the same and varying conditions, both in regard to construction and maintenance, the material on the cards as outlined above has been collated and placed upon white print cloth sheets according to the type of construction. A legend is placed at the top of the sheet by which the different classes and kinds of material as well as the name of the manufacturers can be distinguished. The data on these sheets is featured mainly in material unit cost per mile and maintenance per year. Each highway occupies one line and is indexed under its number and there is room for twenty-six highways on each sheet. Inasmuch as some highways are constructed of several different types, a column is provided for the total mileage; another is provided for the mileage of the type under consideration. Complete information such as kind and thickness of material entering into the different courses as well as the binder used, are shown by abbreviations appearing in the legend. A column is provided in which is recorded the unit cost per mile for the pavement only; another for all other items of construction cost; and a third for the total amount spent for engineer-

ing and advertising. These three items are summed up in a column which gives total cost per mile and the equivalent cost per mile of a 16-ft. pavement is computed and tabulated in order to give instant comparison between highways of the same or different types based on this standard of width. The cost per square yard of the entire pavement and of the top course are given, experience having shown that these items are the ones most often required. The cost of the bottom course can be readily obtained by a little calculation. The maintenance per year will be shown for the first and second years and also the total to date. The cost per mile per year and per square yard per year are given, the idea being to furnish unit costs that will allow a rapid comparison.

For better study of the traffic density we are having a traffic census taken each year and if necessary twice during the year, both before and after improvement. A column is provided to show this. This gives a record of the growth of traffic due to the improvement, and further furnishes us with information by which to adopt other types proper to the locality. A column is provided for the date when the highway is completed, for quick determination of its age.

From the above described sheets we may make rapid comparison between roads of the same type. From a comparison of the average cost of construction and maintenance of these various types, facts will be discovered that should tend to more economic consideration and design than has been had heretofore.

The speaker has attached the cards referred to for laboratory tests and statistics, and those used for the tabulation of highway construction and data, as well as the sheet showing the general characteristics contained in the cards, in the hope that there may be discussion and suggestions for improvement.

As a recommendation to the Pan-American Road Congress, the speaker would like to suggest the appointment of a committee for the futrher consideration of uniformity for highway statistics and data, in order that each department may, in so far as it is possible, aid all those interested in highways by showing not only its successes but its mistakes as well. The idea of this paper has been to convey what the department of the Commission of Highways of New York State is trying to do along these lines, and to give the present solution of its problems only as one attempt toward a solution of the entire problem.

CHAIRMAN MACKENZIE: Is Mr. Marr present? Mr. Marr was to open the discussion of this subject. We would be glad to hear from Mr. Marr if he is here. Is there any one here who would like to open the discussion on this

question? Someone should have a good speech to deliver to us about now as speeches are pretty cheap. Can't we have smeone who will open the discussion on this subject?

JUDGE ALBERT: Mr. Chairman, I haven't a speech, but these papers, first the subject matter, and second the title, would indicate that although applicable to the New York system they don't meet the conditions of the road construction of this coast. There should be some method, some simple method by which the counties, for instance in Oregon where the county is really the unit in the road business and the only authority that can establish roads, could audit and expend all the road money whether it be township or county money. There should be some system so that each year we could segregate the expenditure of money for maintenance and other expenses and that which results in the building of a road which is permanent and is an asset. There is no system at present.

I have urged upon the county court of our county that they take each year, beginning first by taking an inventory of what they have that is valuable. We know what is spent on roads, but that is all counted as an expense. It may be all an expense, a useless expense as far as the roads are concerned, but it may consist of construction which is a good asset, better than putting the money in the treasury. There should be some system, and I have several times urged our county court to take an inventory to see how much good roads they have in the state; how much hard surface, how much good macadam road. Then the future expenditures should be divided so that the people will know how much has been expended in repairing and maintaining these roads and how much has been expended for permanent roads, whether it be hard surface or macadam or whatever the nature of the road. In that way you may judge of the efficiency of the county court. You can't do it otherwise. The politician says we don't want that. We have spent a half a million dollars or fifty thousand dollars and the taxes have increased, while the last court only spent so much and only levied such an amount of tax. There should be some practical way of an accounting, a statement and statistics so that we may know what has already been done and how far we are in advance this year over last year.

MR. JEWKES: I would like to ask a question as to the system used in California in accounting inasmuch as there is such a large expenditure for road purposes. If there is anyone present who can explain the system I would like to hear it.

CHAIRMAN MAC KENZIE: Is there anyone here from California who can answer the gentleman's question? Mr. Jewkes asks for information relative to the California system of handling her funds, or her methods of accounting.

MR. LODER (San Francisco): In answer to the question I will say that I am not qualified to answer it fully, being the division engineer of the San Francisco division. I merely want to call your attention to the fact that the accounting system of the California highway commission was arrived at in the beginning of the work, by the commission deciding that they should employ one of the best firms of accountants they could find to install for them a businesslike system of accounting, such as would be used by the largest corporations. They realized they had a large sum to expend and therefore went to considerable pains and some expense to employ a good firm of accountants who established, with the assistance and guidance of the highway engineer, who was the executive authority, a system of book-keeping, and accounting, and records, down through all of the departments to the field, which would give a history of the work. I am not, however, able to tell you the details of the accounting as it is at the headquarters office, but it is the purpose of the system that the bookkeeping shall all be done at the headquarters office through vouchers, reports and statistics prepared in the field and through the division offices. Everything is prepared in duplicate and sometimes in triplicate and there remains a record in the division office and in the headquarters office. The final result for each section of road is brought together so that at any time at headquarters or the division office the same data may be obtained. The data are obtained with a little more research at the division office, but it is always there, and there is a record in each office that may have occasion to use it. The idea is to make it as simple as possible so that the field men do the work for the book-keeper and for the accountants at headquarters, by indicating on their reports and on their vouchers and on their estimates the segregation of each item of expense so that when it gets to the book-keeper all he has to do is to enter it under the proper head, and they there have segregations for each subject. The main point I want to make is simply the fact that the California system was based upon a system prepared by a firm of expert accountants who went into it very carefully, as it would be done in a corporation. It was modified of course to meet the needs of the road building problem. That was done by the executive authority of the highway commission, which had been two years at that kind of work.

CHAIRMAN MACKENZIE: Is there any further discussion of this question?

MR. JEWKES: I wish to ask a further question. To what extent do you think there should be red tape? We always have quite a complaint among the people that there is too much red tape in the state accounting on road business. I would like to hear from some member of the asso-

ciation as to what extent or how cumbersome should a system be.

CHAIRMAN MACKENZIE: Is there anyone present that can answer Mr, Jewke's second inquiry, or that desires to? We would be glad to hear from them at this time.

MR. MACDONALD: I think the genaleman has in mind getting a little information, Mr. Chairman, in regard to how a commissioner or official in charge of work can bring you down to an A, B, C idea so that the people who are contributing the money to the department, whether it is in millions, hundreds or thousands, can know what is being done with their money. In my own state of Connecticut where I was commissioner for eighteen years, we had a system of our own in this respect. In fact, every state in the Union almost that is engaged in highway reform under state aid and under a highway commissioner or commission has a distinctive personality. With us it was impossible to adopt a unit system at all in letting the contracts. I let all my work for the eighteeen years under the lump sum per lineal foot price. The towns of my state had a certain amount appropriated for their use. All the towns in the state shared pro rata on application for all moneys to be used on inter-town roads. The state in later years contributed all the expense for the trunk line system. That trunk line system, except for repairs, was let by contract. In fact, all the work in the department was let by contract, so that simplified this question of accounts. It was simply the administration. Every inspector and every deputy in charge of the work rendered an account every day to the department and was charged over against that official in his work in that particular locality, or for that particular road. Every contract was charged up against that particular town in which the work was done. The comptroller of the state kept an accounting and he checked that account with the appropriation, and we could not exceed by one penny the amount that was appropriated in my allotment to the several towns of the state at the time the first allotment was made.

In my little opening address I saw that this would develop into or should develop into a meeting of inquiry, for there is no part of highway work in which the people are more interested than in this question of how their money is being spent, and the suspicion is rife always that officials are careless, are negligent or their system is not right. I think it is the high privilege of any citizen of the country to enquire into these great questions of finance. That is the way that our country, if ever, is going to grow a strong confidence in the money placed in the hands of officials along this line or in any line for which public service is required. So I am very glad to have this opportunity to explain what the little

system in Connecticut was. It started with a very small beginning, seventy-five thousand dollars for the entire state, giving the highway commissioner an opportunity which is not the privilege of every commissioner, both in regard to the small area of the state and the opportunity to investigate the condition of the roads, the financial condition of the towns, and everything connected with the system, by placing in his hands a large sum of money. I know that it equipped me in a splendid way for later on taking charge of the millions of dollars that they afterward placed in my hands. So I grew in a simple way to handle the large amounts of money that came to me later, and I am very glad that the question was asked by that gentleman in reference to California; for it enabled me to perhaps throw a little light in regard to one of the units of this great country of ours on how we in a simple way developed our system up into the confidence of the people so they grew from seventy-five thousand dollars a year up to three or four million dollars.

MR. COBB: The question was asked by a gentleman living in a state where conditions are very similar to those in Arizona. The trouble usually in my state has been that there has not been enough red tape relative to the expenditure of money by local boards of supervisors. I know that in any organization where you have expert accountants they are likely to run into red tape. It is a tendency that you have to fight against all the time, but there is a certain amount of so-called red tape that I think every public official owes to himself to be able to protect himself against criticism. You must have an exact accounting of the expenditure of all road moneys. Now I don't know but what we have gone a little bit toward red tape in Arizona, as, for instance, we insist upon the pay roll being signed by every man that is working on the road. It takes some little time to do that, but I think, as I say, that it is necessary to have a certain amount of red tape in public offices. The difference between a public office and a private office, a public corporation and a private corporation is that you don't have to be so careful in the private corporation as you do in the public corporation, because your directors are limited in number and can keep in close touch always with what the officials of the company are doing; whereas in the political corporation every individual in your community is a director. I believe that a certain amount of red tape is justifiable in the handling of public moneys. Now in keeping your accounts there are two things to be accomplished, one is to keep the unit cost data of your work, and the other is for the purpose which I have just mentioned, as a protection to yourself in showing the public where the money has been expended, and that it has been expended as your books and

vouchers will show, for the purpose for which it was intended.

In Arizona we have our accounts carried in sixty-five different segregations in the main office. Now in addition to that we expect the men on the work to keep a further segregation of their costs. Recently at a meeting of the county highway engineers it was suggested that I send my accountant out to all the counties to establish a uniform system of accounting for highway work in all the counties of the state. This is now being done. Most people do not seem to realize the necessity of having a most expert and competent man in the position of chief clerk or chief accountant in highway construction offices. I believe that the office of chief clerk or accountant is just as important as any other office connected with highway work.

MR. JEWKES: I am very much interested in this subject and I am asking a number of questions for the purpose of bringing out discussion. Now I would like to ask a further question as to which you think better, to conduct your accounting as a unit or to conduct the accounting by the number of counties that you have within the state. By this I mean whether or not all these disbursements for state road construction in connection with a county should be through the state office or segregated into a number of counties that exist. For the purpose of understanding what becomes of your money, which is the more preferable, as a unit or divided into the counties in which the work is done?

CHAIRMAN MACKENZIE: It seeems to me Mr. Jewkes that that question is one that could only be answered as to the requirements of each state. It depends upon what the statutory provisions are that you are building roads under. In our state we have a permanent highway law which expends only county money. That is accounted for by the county commissioners. The state highway money is spent by the state highway commissioners and is accounted for by them. I think the remarks of Mr. MacDonald were very pertinent to the question that the main point to always have in mind for highway officials is that the taxpayers is "it," and to follow the principle that guides us all in our business that absolutely accurate account should be kept of money expended.

In banking I know there is a rule that where a firm or individual runs his business without any books, and it comes to the knowledge of the man loaning the money, it cuts down his credit. Consequently the taxpayer loses confidence unless a thorough and full acounting is made of his money, and the taxpayers in our state have been awfully good to us fellows that are trying to build good roads up there, and we go to them absolutely with the greatest of confidence with

the showing that is just as much in detail as can be had, because that is the only way that you can retain their confidence and have them continue to put up the big sums that they are expending. Is there any further discussion on this subject?

MR. TERRACE: I might say that in the state of Washington there are three public accountants appointed by the state. It is their duty, if any citizen of the state calls upon them, to go through the books in any office in any county in the state. I believe in that method. I believe that the safety of the taxpayers requires it. I might illustrate this to you. In the valley that I live in we formed ourselves into a district. There was a law enacted for that purpose. The law called for the engineer to go over the ground to ascertain the number of acres that were going to be benefited by the improvement and to ascertain the cost. The next step was that the electors in that district should elect three of their own citizens as commissioners at the fall election. We had our day in court to show why or why not the improvement should be made. We were asssessed something like seven dollars and fifty cents an acre against our land which had to be paid in four payments. I paid my four payments with the rest of them. I went up to pay the taxes and there was a drainage tax against the land. I says, "What is this?" "Drainage tax." "Why I paid it." "Well, there it is" "Well, I will not pay that. You take the rest of my tax." The deputy said he could not do that and I went into court to mandamus him to compel him to take the balance of my taxes. The judge decided against me. I immediately appealed to the supreme court and the supreme court said it was an illegal tax; I had no right to pay it, that I had paid my tax. I then appealed to this board of accountants that had been created to go over the books and they found that the commissioners had spent twenty-five thousand dollars of the farmers' money of which they had kept no records; in other words, it was just a cold steal. We sued them and their bondsmen. They were secured by security companies. We have recovered a good deal of that money. So that I am in favor of red tape. (Applause.)

MR. LYMAN (Utah): I would like to ask the gentleman how often they pay their bills, how long it takes to pay the bills after they come in, how often they pay their men who do the work, and how long it takes to pay their men after the pay-roll comes in, how long it is before a man gets his money?

CHAIRMAN MAC KENZIE: Can someone give the gentleman the information he has asked for?

JUDGE ALBERT: I will say that in Oregon the county court meets monthly, audits all the bills, and the payments are then made.

MR. LYMAN: How long does it take?

JUDGE ALBERT: The county court is held the first Monday in every month. The county court sessions last usually three or four days, so that by the end of the week always the record is made up.

MR. EDDY: In regard to the state of California, in reply to the gentleman from Utah, I wish to say that the state highway, and the commission that keeps the accounts and is building the highway, is only a part of the road system, a part of the road almost. We have three laws in this state that are generally followed, and other laws that are only incidentally followed. One is the state highway act under which the bonds were issued, eighteen million dollars, of which the state has control. And I wish to call your attention again to the point I made yesterday, that in this state, when we consider the highways, we are considering only rural highways. They have nothing to do with the incorporated cities; they are the roads that lead from city to city or through the country. The city streets are considered a police regulation. The eighteen million dollars to build three thousand miles of state highway which have been adopted, and which may be enlarged, would constitute about seven per cent. of the roadways of the state, and therefore is only a part of the system. Various counties have bonded under another law, which we term the Savage Act, and those counties have spent possibly from ten to fifteen million dollars, probably more. About twelve counties have adopted this system and I think bonded. In the counties which have adopted the bonding system under the Savage Act, and in the state system, the accounts are well kept and any newspaper man, such as I am and such as I have been for twenty years, can ascertain the exact data to give to the people, but the larger proportion of the roads of California are directly under the supervisors under what we call the county government. They expend annually something like three million five hundred thousand dollars because the state law permits them a maximum of forty cents on a hundred dollars worth of property, and in many of the counties they have raised it for extra purposes to sixty cents, and so they raise at least three million five hundred thousand dollars to be expended annually in the upkeep or repair of the ordinary roads. Those accounts are paid by the supervisors. There is no account kept except the claim made against the supervisors. I am speaking generally now and possibly in some counties there is some other system adopted. Mr. Morton, who was sent out here by the United States Office of Public Roads from the Department of Agriculture, submitted I think a complete report from one of the counties of the state to the United States government. Whether it was ever published I

don't know, but in that he devised and submitted to the supervisors and recommended the adoption of a system of accounts so that the county clerk or any auditor of a county might keep an exact system so that anybody, any taxpayer or any inhabitant of a county, could obtain the exact expense of any road. I don't think that generally has been followed. The claims that come against the supervisors are paid up when they meet once a month, and they must be submitted, filed and sworn to before the clerk three days before the supervisors meet. That is the way most of the money is expended and the claims I presume go into the archives of the county; you might say the debris of the county, where it would be almost impossible for anyone to hunt them out.

That is the exact condition, and I think that a few years ago the state had a committee appointed consisting of Mr. Nye, Mr. Williams, the treasurer, and one other gentleman to devise some system of accounting that would prevail throughout the state, not only in the cities, the municipal or county organizations, but in good roads matters, but it was never adopted. It was never made the law. I think the prevailing custom in California for the ordinary roads in the expenditure of three million five hundred thousand dollars, is just as it always has been, you might say, thrown into the waste pile where nobody looks it up afterwards unless there is an inquiry, and it is dug up. Now of course we have in almost every county, I guess in every county, experts who annually go over the accounts and if anything is decidedly wrong they bring that up and make it public, or it will appear in their report. I think Mr. Loder, with whom I am not acquainted, will affirm that the ordinary roads have no system of accounting in any county of the state, that is, in the ordinary county.

MR. JEWKES: I have asked for a little information and I am glad to have received it. Now I am willing to state for just a moment or two a little about the system we use in Utah. We have followed rather a red tape system, at least we have been so criticised by a number of people residing in different parts of the state or within the counties. Our finances are raised in this way. Out of general tax received for roads the state appropriates a certain sum to be expended within the twenty-eight counties. In addition to this the counties are required, in order to participate in this fund, to appropriate a certain proportion, some appropriating one-fourth of the amount, some one-half and some an equal amount, according to the size or class of the county. When this money is required for the meeting of disbursements or payment of claims and pay-rolls, the requisition is made by order of the commission or the secretary thereof to the county treasurer for the amount required from the county,

this to be of the county appropriation which is made from the general fund, and also a fund received by taxation. Under our present law, which is a county unit law, a tax not to exceed five mills is levied in the county that is engaged in state road building. When this tax is collected it is requisitioned by the secretary of the state road commission in a like manner. When material is purchased or expenditure is made for any materials or supplies for state road purposes the state road agent appointed in each county has to approve all those claims, and as he makes purchases he forwards a notice of purchase to the state road office setting out the various materials and the prices thereof in quantities, etc. Then we get a bill from the firm which corresponds to this notice of purchase. We try to have as many checks upon our system as possible and therefore of course it makes it a little cumbersome, but while our system is a little cumbersome I still feel quite proud of it. Any material or any implement, anything that should appear in an inventory, can be kept track of and in our system we know just what has been purchased in the way of equipment from a plow or a leveler or a trowel up, and a bill card is made as soon as a notice of purchase arrives at the state road office, of any material, especially that is not going to go into the construction of the road, that should appear in an inventory, such as a chain or a scraper, a plow or anything of that kind, so that the road office knows in every county in the state of Utah just how much equipment should be on hand. These state road agents are placed under bond to take care of all the equipment coming into their hands.

Time-sheets are made out. We have account numbers. For instance, if a man is clearing the right of way, grubbing brush, we have an account number to take care of that so that we know just what it costs to clear the rights of way. We know what it costs for engineeering service. We have an account number for every class of work on the state road. I feel that our system may be perhaps a little cumbersome. All our claims have to be sworn to and verified and approved by first the state road agent, then the state road engineer, who knows what is going on generally in each of the counties and then by the state road commissioner in charge. We have five members of our state road commission, each member having a given territory. I feel that perhaps I have occupied more time than I should, but I felt like making these few remarks along this line. (Applause.)

CHAIRMAN MACKENZIE: This congress has been remarkable in many ways. It has been one that has had some of the best and most technical papers read to it that I have ever attended. We heard it rumored when we first came here that there was an exposition in San Francisco, then it was whispered to us and finally told us, and then in one or

two speeches or perhaps more than that we heard all about it, yet that fact has not kept any away from the business sessions of our congress. And here we are on the exposition grounds in one of its buildings grinding away with road matters. We have had no recess for three or four days and it has been suggested that possibly it would be advisable at this time to consider taking a recess, for the reason we were told last night that there are sixty-eight acres of ground covered by this exposition, that you would have to walk sixty-five miles to see it all and forty more if you take in the zone and side concessions. Of course none of us will care to take in the zone, but a great many now present will have to walk that sixty miles between now and six o'clock. It has been suggested for that reason we consider a recess. The objection has been made that the paper—Mr. Hubbard has to catch a train, and it has been suggested that his paper be submitted for your consideration by title tonight only and discussed at the business session tomorrow at Oakland. In that connection I would say that the sessions of tomorrow will be held in the Municipal Auditorium in Oakland in accordance with our official program. The paper that was to be submitted here, "Engineering Supervision for Highway Work," by T. H. MacDonald, State Highway Commissioner of Iowa, will be read by title. Mr. MacDonald is not here. Mr. Prevost Hubbard has written the paper on the question and the matter is to be discussed by Mr. Cobb. Mr. Hubbard's paper has been submitted and I read its title, "Engineering Supervision for Highway Work."

Engineering Supervision for Highway Work

By PREVOST HUBBARD

Chief, Division of Road Material Tests and Research, Office of Public Roads and Rural Engineering, U. S. Department of Agriculture

That the laboratory is generally conceded to be a valuable asset in highway engineering supervision needs no argument. Sufficient evidence of the fact is at hand in the establishment and maintenance of numerous chemical and physical testing laboratories in connection with municipal and state highway work. The importance of this branch of highway engining supervision is, however, often underestimated, and the maximum value of the laboratory is seldom developed. In many instances laboratory work is misapplied and then it may actually become a handicap to efficient work. The proper use of the laboratory rests largely with the highway engineer. His needs should determine the lines of work which are undertaken and should govern their application to practical field conditions with which he is confronted.

During his intimate association for over ten years with

both laboratory and highway engineering work, the author has had exceptional opportunities of studying the relation of the two under varying conditions and is convinced that in many cases there exists a lack of cooperation and coordination of interests which is largely the fault of the engineer. He believes that the laboratory is not only an asset but an absolute necessity to efficient highway engineering supervision, and feels that existing conditions may be greatly improved if the attitude of many engineers toward the laboratory is modified.

For the purpose of discussion, road and paving material laboratories may be divided into four classes:

1. Commercial routine testing laboratories.
2. Laboratories under the direction of a consulting engineer who is a specialist in highway work.
3. Municipal laboratories.
4. State, and in exceptional cases, county laboratories.

Of these the commercial routine testing laboratory is usually of least value, being merely a machine for grinding out results. If, however, such a laboratory is under the direction of a specialist in highway work, its usefulness is of course greatly increased. In fact, for any specific piece of highway engineering supervision the laboratory in charge of a highway expert is the most efficient type, as the director of the laboratory is in intimate touch with the actual use of the materials tested and knows exactly what they have to withstand in service and the conditions under which they will have to be used.

The municipal laboratory is, or should eventually develop into, this type, if in charge of a capable chemical or testing engineer, for the reason that this engineer will have ample opportunity to familiarize himself with all of the local conditions which have to be met in his municipality and of studying the behavior of the materials tested, under practical service conditions. His advice and cooperation should be sought by the chief engineer, who should also keep in close touch with, and understand the work of, the laboratory. Too often, however, the chief engineer fails in one or both of these particulars, and unless the director of the laboratory possesses exceptional ability and initiative he is apt to become discouraged and allow his work to degenerate into purely machine-like routine.

While it is seldom possible for the highway engineer to become a chemist, there is but little excuse for the general attitude he assumes regarding his knowledge of some of the materials which he is called upon to use. This is particularly noticeable in the case of bituminous materials. Without wishing to appear too critical, the author feels safe in stating that a comparatively small proportion of highway

engineers who use bituminous materials are able to interpret ordinary reports upon the chemical and physical characteristics of such materials. There is some excuse perhaps for those who are unfortunate enough to be denied the service of a laboratory, but the fact appears to be true for many engineers in state or county employment who have such service available. The author has interviewed many engineers upon this subject and the general feeling seems to prevail that there is no necessity for acquiring more information than that a given material meets or fails to meet a given specification. No thought is given to what a variation from the specification signifies, and but little thought to the specification itself, for that is what the laboratory is supposed to attend to.

The laboratory, on the other hand, may seldom come in contact with the engineer who actually supervises the work, and the director of the laboratory may not even be given opportunity to see the use and behavior of materials which he specifies and examines. If this is so he is working in the dark, and it is due more to good luck than to good management if a suitable material is secured. When a bituminous material laboratory is first started it has not been an uncommon practice to place it in charge of a chemist who has previously had absolutely no training or experience with bituminous materials. One of the first things this chemist is called upon to do is to prepare specifications, a duty for which he is absolutely unqualified until he is given some field experience and an opportunity to study bituminous materials both from the engineer's and the chemist's points of view. This is particularly necessary where a state laboratory is involved, because of the widely varying conditions which will probably have to be met in different parts of the state, and the fact that it will be impossible for the chemist to secure the desired information if he is not given ample opportunity and encouragement in this direction.

In the foregoing discussion the author has attempted to emphasize the following facts:

1. That the highway engineer should acquire the fundamentals of highway material testing and the significance of the results of tests.

2. That the highway chemist should become familiar with the use and behavior of the materials which he tests.

In addition to this it is extremely important that the engineer and chemist should frequently meet in conference of past work and cooperating in the preparation of specifications for future work. In this way only can the maximum value of the laboratory be obtained in highway engineering supervision. These facts would seem to be almost self-evident, and yet it is the exception rather than the rule when they are appreciated and observed.

In any permanent highway engineering organization it is also important that complete history cards be kept on the construction and maintenance of each highway. Besides the more important engineering details, these cards should contain a record of the materials used, specifications under which they were secured, and their behavior under service conditions. The serial numbers of samples of material examined should also be included so that the complete reports upon these materials may be readily located for reference. In a comparatively short time these cards will be found of great value in the preparation of new specifications and will intimately connect the laboratory with the purely engineering work of the organization.

As the methods of the laboratory become understood by the engineer he will find the laboratory of increasing value in his supervisory work. Not only will he find it of service in selecting and securing the materials which he employs, but in many instances he may utilize it to check up his own inspection and also the work of the contractor. Comparatively few engineers who have not been engaged in municipal paving work, in connection with which an efficiently conducted laboratory has been utilized, appreciate the amount of valuable information that the laboratory may give them. For instance, in the supervision of the construction of a bituminous concrete pavement upon a Portland cement concrete foundation, the following services may be rendered:

1. Advice relative to specifications for securing suitable materials to be used in a given way under the given set of local conditions as determined by the engineer himself.
2. Examination of materials to ascertain whether or not they conform with the specifications adopted. This will include routine physical tests upon stone, or gravel, and sand for both the foundation and wearing course, routine tests of Portland cement and examination of the bituminous material.
3. Advice relative to the importance of slight variations from the specifications as prepared.
4. Daily examination of mixes as prepared for use.
5. Examination of sections of the wearing course of the completed pavement.

It is unnecessary in this discussion to enter into all of the details of the work of the laboratory under these various items, but it should be noted that daily laboratory reports will be required during most of the period of construction. The laboratory service and inspection will therefore constitute an appreciable portion of the engineering supervision. The cost of much service may in fact represent about one-quarter or fifth of the total cost of supervision, assuming that the supervision is adequate and efficient in all particulars. In other types of construction the cost of laboratory

service may be very much less proportionally, and in exceptional cases it may be greater.

The desire to reduce the cost of engineering supervision to a minimum, even at the risk of inferior supervision, frequently proves to be the poorest sort of economy. Far too often elaborate specifications are prepared and never enforced through lack of laboratory assistance. A specification is of but little value to the engineer unless he has means at his disposal whereby he may determine if his specifications are met, and yet in the author's experience many cases have come to his attention where, for instance, no examination is made of a bituminous material whose chemical and physical characteristics are nevertheless specified in detail. It does not take either the manufacturer or the contractor long to size up such a condition of affairs, and no matter how honest they may be in intent, the work is likely to suffer in more ways than one.

In conclusion the following may be cited as one of many examples which are of common occurrence. But a short time ago the author was engaged as a consultant upon a case involving a bituminous pavement which had failed shortly after construction, although supposedly laid under specifications which had formerly proved satisfactory. Upon investigation but little fault could be found with the specifications. In conversation with the city engineer it developed, however, that the average highway engineering supervision for that city amounted to less than two per cent. of the cost of the work involved, a fact of which he was apparently very proud. For that particular type of construction the cost of adequate laboratory inspection alone should have been not less than 1½ per cent. By means of the laboratory it was later shown that the specifications had not been met, and that this was the primary cause of failure. The city became involved in expensive litigation with the contractor, who finally won out on technicalities, leaving it with little to show for thousands of dollars that had been expended. This loss could have been entirely prevented had the laboratory been used as an adjunct to the engineering supervision.

(The following paper was also presented for insertion under this subject.)

Cost of Engineering Supervision

By LAMAR COBB
State Engineer, Arizona

The most important features of engineering supervision for highway work are the sufficiency of such supervision and the cost thereof. The cost should, in a measure, indicate the sufficiency. To ascertain for comparative purposes the cost of all "overhead" expense, including engineering super-

vision in the several states, I addressed the following letter to all the state highway departments:

"We wish to ascertain if possible information concerning costs of administration and engineering of highway and bridge construction, and would appreciate any data you can furnish relative to your construction and any suggestions you care to offer. The following segregation, we believe, covers the subject:

"1. Percentage of total cost finished construction for surveying, plans and specifications. Graded roads, hard-surfaced roads and bridges separately;

"2. Percentage of total cost finished construction for engineer and assistants for laying out and inspecting during construction. Graded roads, hard-surfaced roads and bridges separately;

"3. Percentage of total cost of finished construction for administrative expense (executive's salary and expense, together with office);

"4. Average percentage you estimate for total engineer and administration;

"5. Outline of your method of keeping segregated costs as above.

"As our legislature is now in session and has in view a revision of road laws this information will be of great importance to us, and we wish to thank you in advance for your kindness in furnishing the same."

The replies received developed the following interesting facts:

1. There is no uniformity among the several highway departments in the keeping of such cost data. This prohibited tabulation of such cost.

2. There is no uniform rule governing proper engineering or administrative charges.

For instance, on contract work some charge the local inspector to engineering and some to construction.

3. Percentages of engineering cost are in some states calculated from construction cost; in others upon construction plus engineering cost; in others upon construction plus engineering, plus equipments costs, and still in others upon the entire amount expended, even including administrative cost.

4. In some instances the percentages are obtained from a record of yearly expenditures and in others by collecting the results from completed work.

5. Salaries and expenses of executive officials are in some charged as adminstrative expense and in others no charge is made.

6. The desirability, if not necessity, of some uniform system that would meet the requirements of all the states in the keeping of administrative and engineering as well as other cost data.

7. That the cost of engineering, as shown by the letters received, vary to such a great extent that, after taking into consideration the amount of money expended, the area over which operations are carried on, and the character of the work, it is quite evident in some cases that either the necessary engineering work has not been done or it has been improperly charged off to construction.

Digest of Engineering Costs Reported.

Alabama: Bulletin No. 4 shows that in twenty counties the percentage for plans and surveys was about 3 per cent. and for engineering during construction the percentage was about 5.9 per cent. of the total cost of construction. The cost of all engineering work would be, therefore, about 8.9 per cent. of the total cost of construction. The administrative charges are not shown.

Arizona: The percentage for plans and surveys is 4.6 per cent. and for engineering and inspection during construction 4 per cent., or total engineering and inspection, 8.6 per cent., based on total cost of construction and engineering. The cost of executive and administration is 3.6 per cent., making grand total overhead expenses 12.2 per cent.

Connecticut: The percentage for surveys, plans, etc., is about 0.88 per cent. of 1 per cent., and for engineering during construction about 4.94 per cent. of the total cost. The cost of the work done by the state highway commission in connection with roads and bridges amounts to about 0.7 of 1 per cent. of the total expenditures of the various counties on roads and bridges.

Kansas: On bridge construction the percentage for plans, estimates, specifications, etc., averages about 1 per cent., and for engineering supervision and inspection from 2 per cent. to 5 per cent. of the contract price, making the cost of all the engineering and supervision about 4.5 per cent. of the total cost of the work. On road construction the percentage for all engineering and supervision on macadam and concrete roads is about 8 per cent. of the contract price.

Maine: The percentage for surveys, plans, specifications, etc., is about 2.27 per cent., and for inspection and engineering supervision about 3.58 per cent. of the total cost of the work. On small work it is estimated this percentage will be as high as 10 or 11 per cent.

Maryland: On the state aid roads completed between June 1, 1910, and December 31, 1913, the percentage for survey, plans, estimates, etc., was about 0.5 of 1 per cent., and for engineering during construction about 3.2 per cent. of the total cost of the work. The percentage for other engineering and administration was about 4.7 per cent., making the cost of all engineering and administration about 8.4 per cent. of the total cost of the work.

Massachusetts: The percentage for surveys, plans, etc., is about 1.9 per cent., and for engineering during construction about 4.5 per cent. of the total cost of the work. The cost of administration is about 1.2 per cent., making the cost of all engineering and administration about 7.6 per cent. of the total cost of the work.

Minnesota: For the year 1914 all the expenditures for engineering and supervision amounted to about 5½ per cent. of the total cast of the work done. Mr. Geo. W. Cooley, state engineer, states that he believes this amount to be smaller than is desirable. He believes very nearly 10 per cent. is necessary for actual close supervision.

New Jersey: On twenty pieces of work the average percentage for surveys, plans, etc., was 1.8 per cent. and for other engineering was 4.1 per cent., making the cost of all engineering about 5.9 per cent. of the total cost of the work. The cost of administration was not given.

New Mexico: On bridge construction the expenditures for engineering and inspection amount to about 3 per cent. of the total cost. On road construction the expenditure for engineering and inspection amount to about 5.2 per cent., and for administration and office engineering about 7.42 per cent. of the total cost of the work. The cost of all engineering and administration on road construction would be about 12.62 per cent. of the total cost of the work.

New York: The report of the Commissioner of Highways for 1914 shows about 11.2 per cent. of the total expenditures to be for engineering and inspection and about 3 per cent. for administration, making the cost of all engineering and administration about 14.2 per cent. of the total expenditures.

North Carolina: The information available covers a few roads only and shows that about 4.06 per cent. of the total cost of the work was expended for engineering and inspection. The administration charges appear to be in addition to the above.

Ohio: Bulletin No. 22 shows that about 5.71 per cent. of the total cost of road construction was expended for engineering. The cost of administration appears to be in addition to the above.

Oregon: Upon various pieces of work reported for year ending November 30, 1914, the cost of the engineering varies from about 4 per cent. to about 9.4 per cent. of the total cost of the work. The cost of administration is not shown separately.

Pennsylvania: The report for the year 1913-14 shows the expenditures for engineering and inspection on completed contracts to be about 5.6 per cent. of the total cost and for administration about 1.4 per cent., making the cost of all

engineering and administration about 7 per cent. of the total cost of the work.

Rhode Island: On paved roads the expenditures for surveys, plans, specifications, etc., amount to about 2 per cent. and for engineering and inspection about 2 per cent. of the total cost of the work. The percentage for administration amounts to about 5 per cent., making the cost of all engineering and administration about 9 per cent. of the cost of the work.

Virginia: The expenditures for all engineering and inspection amounted to about 5 per cent. of the total cost of construction in 1914. The commissioner states, however, that in his opinion a larger percentage would result in a substantial saving to the state.

Wisconsin: In 1914 all overhead charges, including engineering and administration were slightly under 5 per cent. on road construction. The inspector on the work is, however, charged to construction. The cost of preparing plans, etc., for bridge construction was about 2.8 per cent. of the cost of construction.

CHAIRMAN MACKENZIE: The discussion of this paper, unless there are those who have different ideas, will be had tomorrow morning at the morning session of our convention in Oakland. In connection with seeing the particular exhibits in the Liberal Arts building, as spoken of by our chairman at the beginning, I will say that this letter was handed to me addressed to Major Crosby, of the Pan-American Road Congress:

"Dear Sir—Anticipating the limited time at the disposal of many of those attending the congress now in session, and in view of the fact that the Liberal Arts palace at the exposition contains many exhibits of specific interest to engineers of enterprises greater or less in magnitude, the Liberal Arts Progress Club has appointed a special reception committee, comprising practical engineering problem demonstrators, and has secured the special privilege of keeping the Liberal Arts palace open until 8 P. M. on Wednesday evening, September 15.

The reception committee, Mr. A. E. Welti, chairman, will wait upon you and arrange details for demonstrating to any number of your members in a body in the most brief and practical manner, and otherwise contribute to make your visit to the Liberal Arts palace pleasant, profitable and instructive.

Yours respectfully,

Liberal Arts Progress Club,
Per Thomas C. Butterworth, Secretary."

Is Mr. Welti present? He said that he would be here at five-thirty; I presume at the front of the building, to conduct the members to the Liberal Arts palace providing we see fit to adjourn at this time. Gentlemen, what is your pleasure?

MR. TERRACE: I move we adjourn.

MR. COBB: I second the motion.

MR. WELTI: Mr. Chairman, I will say that we extended this invitation in the hope that we would save some of the delegates time in visiting the building and seeing the exhibits of particular interest. We have over in the building in the New York state exhibit a model of the barge canal. We also have a model of the Panama canal; and a number of engineering instrument manufacturers and a few other concerns are exhibiting engineering appliances that may be of interest. I could take the delegates right to those exhibits if they so cared to take in the Liberal Arts building first.

CHAIRMAN MACKENZIE: We will adjourn and meet down in front and visit the Liberal Arts building in a body.

An adjournment was then taken until September 16, 1915, ten o'clock A. M., at the Municipal Auditorium, Oakland, Cal.

SIXTH SESSION

Thursday Morning, September 16

PACIFIC HIGHWAY DAY

JAMES H. MACDONALD: We will open this meeting without formality and proceeed to business. I had a reasonable hope that this being Pacific Day we would have so large an attendance that we would have to call on the janitor to provide camp stools in the aisles, but the counter attractions have taken them away or we are a little early. I think perhaps before the day is out we will have a larger attendance.

I respectfully call your attention again to the change of time of the meeting of the American Highway Association. The annual meeting of the American Highway Association will be held in the Auditorium, Oakland, on Thursday at twelve o'clock noon, immediately following the adjournment of the regular session of the congress. All members are urged to be present. This notice is made at the request of S. E. Bradt, member of the executive committee. There will be a meeting of the American Association of State Highway Officials at three o'clock at Hotel Oakland.

I want to call the attention of the delegates to this one fact. It is hardly necessary to say to those of you who have been in attendance at our sessions that for various reasons quite a number have been absent; but they have sent in their papers and there is no phase or incident connected with highway improvement but has been carefully treated. Each step in highway construction from its inception away back in the early days when New Jersey, the mother state of state aid, started, down to the present time, has been carefully gone over. That will make, when printed a compendium of valuable and useful information which no library should be without. No man who expects to follow the science of road

building as a profession or who is engaged in an official way in taking care of highway improvements, whether it is in a town, a county, a city, a state, or in a national position, can afford to be without these proceedings. Now these proceedings will be the possession of every member of the American Highway Association, and every member of the American Road Builders' Association in good standing last June and presented to every delegate in attendance at this convention who has become a temporary member. The executive committee has placed the nominal price of two dollars for those temporary membership tickets and you can secure, and only in this way, temporary membership so as to get a copy of the proceedings. The young ladies outside in the lobbies have the tickets, and will you please excuse me for devoting so much time to this matter. It is not trivial. It is important by reason of the fact that so many have been away.

We will now take up the program in its regular order. I had thought at first that I would continue the program that was interrupted yesterday so pleasantly, but I think in justice to the gentlemen who have put in an appearance, and so as to keep our program intact, and have the whole of these proceedings go along in order, I think yesterday's session should properly be considered at an end. If at the conclusion of our work this morning we have time for discussion we may continue it then, or this afternoon. So we will now proceed with our regular program. You will notice that we are now coming down to very near its conclusion. We have been through an analysis, we have had considerable deduction, and naturally today and tomorrow would be to conclude the matter as we go along. And I know of nothing better, as we stand at the threshold properly digesting these papers and these splendid addresses that have been delivered, than to take up this great question of the merit system. Yesterday we had the natural sequence of giving an accounting for the money placed in the hands of the officials. Now we are to consider who the officials are to be and how long they shall remain in office.

You know it is not only necessary to build a good road, but it is absolutely required when you have built the road to commence immediately at the conclusion to take care of it. So we want to take up now the men who are to continue to take care of it. There are three things that we have got to look out for here in America. It is not so much the wear of the road; it is not so much the question of the amount of money; but it is the question of going back and making a retrograde movement by reason of three things: predatory interests, commercialism, and politics. And with that introduction we will proceed to take up the first paper. I was looking for Brother Powers, fearful that there might be

some important announcement that I might omit and I see that my judgment was not at fault. Brother Powers informs me that a little mistaken idea has occurred;—that the committee on resolutions who are to meet this morning, that some of the members of that committee thought perhaps it would meet here. But the fact is the committee is meeting down at the Hotel Oakland and is in session now, so that if there are any members of the resolutions committee it would be well to repair to that committee and take up the question of resolutions, for that is a very important matter. I regret to say that Brother Hill is a member of that resolutions committee and I had hoped to have him with us this morning. We shall be very glad to have Brother Hill say a word before he goes. I would suggest that inasmuch as you are here, Mr. Hill, and are going to read Mr. Richardson's paper, that it would be well to read his paper for us after your remarks.

Address by Samuel Hill

President, Pacific Highway Association

Mr. Chairman, Ladies and Gentlemen: I don't very often differ with my friend, Mr. MacDonald, because Mr. MacDonald is the prophet in Israel who first preached the gospel. I have got to differ with him this morning very materially and very radically. He said he had hoped there would be a large meeting here today. He did not see quite why it was that so few came here to the meeting. That is a matter I think entirely unimportant, how many come, how many go away, or how many stay. Coming over on the ferry this morning there were four automobiles filled with people from Oregon and Washington all of whom I knew. They had come down, they said, to attend this good roads gathering. None of them are here. I suppose I saw many hundreds in San Francisco whom I knew, none of them are here. When we had a meeting at Blaine, Washington, on July Fourth, of which I spoke the other night, there came between four and five thousand people at my personal invitation to be there. We had a great meeting. I am going to tell just one little story to illustrate what I mean. I don't believe that numbers count.

How many have ever heard of Father Duncan? Father Duncan, a Roman Catholic, is the man that rules in the northern country for almost two thousand miles. Under him are a series of men who believe what he says. He is the real government there. Years ago there came along the coast a British bark, and aboard was a young man who was a preacher. He came out for his health. When he came to that northern Pacific coast he found Indians there, heathen, barbarians. They had never heard the word of God preached. It worried him very much indeed. He labored in

spirit that this should be so. He went back to England with that still on his mind. He went to the pastor of his church and asked if he might hold a meeting to tell the needs of these men on the great western coast of Alaska who had never heard the word of God. The pastor said, "Yes." They fixed a night. That afternoon about four o'clock there came the most dreadful storm England had known in thirty years. Rain fell in torrents, lightning flashed, there was turmoil everywhere, a convulsion of nature.

The hour came for the meeting to be held and there was present nobody but the young man and the pastor. It was still raining, still thundering,—storm still going on. Eight o'clock was almost ready to strike. The door opened. In came a man with a box of tools on his shoulder, a carpenter. The young man reached out his hand to him and told him how glad he was that he had come to the meeting. He said, "Why, I didn't come to the meeting. I didn't know there was any meeting. I only came to take refuge from the storm." "Well," said the young man, "we are glad to see you. We are ready to begin now." "Why," the pastor said, "young man, are you going to talk just to me and this carpenter?" "Yes," and he talked. He told the needs of all that north coast. He told what it all meant, he told the story, and then with a smile on his face, shook hands with the pastor and the carpenter and said good-bye. He stepped outside. The storm had stopped. The moon shone clear. The stars came out one by one.

A few days afterwards a man greatly troubled in spirit came to the Baptist preacher of the town and said something was on his mind. The pastor asked him what it was. He said he must go to minister to the needs of those Indians, the people on the north coast of British America. "Why, can you do anything?" "Well, I think I ought to. I think I ought to go." "You do, do you? Who are you?" "I am the carpenter." "What have you got?" "I have got twelve pounds. I have got my tools." The pastor said, "Why, you are going out with twelve pounds to convert all North America? Pardon me, you are a joke." "No," he said, "it is not a joke. I am very serious." And so he came and so he went. He took his little property and twelve pounds and same to British America and there held meetings, one at a time. What was the result?

That man, the despised carpenter, is Father Duncan. His word is law for two thousand miles and thousands of people believe in him. Do you think I care how many people come? No. Sometimes I want one man for an audience. Sometimes I have had five thousand, sometimes eight thousand. The number cuts no figure. Maybe I may speak to one man.

Well, in the northwest we began, Brother Frank Terrace and I, in Oregon, and it was like the work of the missionary

in Africa who came to preach the word of God. He brought with him wheat and he gave them bread. They liked the bread. He said, plant the wheat and they would have bread. They planted the wheat, the natives did. They dug down to the bottom and found no loaves of bread. They looked on top and found no loaves. They killed the missionary. Their one hope was gone. So Brother Terrace came to tell them how to plant their wheat up there, if you please, among the farmers of Oregon.

There was a man, a multi-millionaire, who owns the best building in all Portland, who had amassed a great fortune starting as a common laborer working for eight dollars a month. He said he was going to leave this country and go abroad. His friends said, "you can't go. You must stay here. You must help us get this country in shape." So John stayed and John gave his labor for two years. John is John B. Yeon, the road master, who has done that great work in Oregon under Major Bowlby. He had Simon Benson, who was here the other day to be honored, as the first citizen of Oregon. They came here with trumpets and banners and guns to honor him. Why? He was a cook in a lumber camp. He went to work and amassed a great fortune. He was admitted to the clubs. He came to our meetings and heard talks and so he had a vision and he gave one hundred thousand dollars for a trade school; gave one of the beautiful parks that you will see in the pictures this afternoon that I will show you. He was the first man to be honored from the state of Oregon.

So I defy you, Brother MacDonald, to prove that I am not right and you are not wrong. Who cares how many come? Have I answered it? Are you satisfied? Do you apologize? (Laughter.)

Mr. Clifford Richardson is one of the men, perhaps the man who knows more about this subject than any other man in the world. Mr. Clifford Richardson is the great authority on the question of asphalt. He is a great chemist. He is the man that England looks to for advice. He is called in consultation in France, and needless to say the man that holds first place in our country. Mr. Clifford Richardson always finds time to lay aside his duties and always attends our road meetings. He went with us, if you please, to the Road Congress in Paris.

And now I look up and see back in the back of the room, a very modest man, a man named George Cooley, of the Minnesota Highway Commission. That calls up other memories. You wouldn't think a young looking man like that could have been a middle-aged man when I was a boy. We worked together in Minnesota and built eighty-five miles of road before I left that state. He is keeping to the same

good work and he is yet right on the job. Is that right, Uncle George?

MR. COOLEY: That is right.

MR. HILL: Mr. Richardson I have told you about, and this is his paper.

The Determination of the Justifiable Outlay for Specific Cases of Highway Improvement

By CLIFFORD RICHARDSON
Consulting Engineer, New York, N. Y.

In opening a discussion of this very broad subject, which may be made to cover the entire field of road construction, both from a structural and economic point of view, some limitation must be set upon those points in connection with the question which may, in the limited time at my disposal, be taken up. I shall confine myself, therefore, to that field of the justifiable outlay, and the care necessary in making it, in connection with highways carrying heavy travel, or more than the average amount, and to bituminous forms of construction.

The justifiable outlay in the construction of a road is a function of the travel which it is called upon to carry, and this necessarily implies the adaptation of the form of construction to the load to be sustained, the frequency of it and the speed with which it proceeds. There is no rule that can be applied to such a situation. Each case must be considered and decided upon its merits.

The justifiable outlay should be one that will give an adequate return, under the service to which the surface is to be subjected. It should be one that service tests have demonstrated will, with proper maintenance, accomplish an economical result.

The justifiable outlay must not be looked upon from the point of view of first cost alone, but of first cost plus maintenance during the life of the surface, the cost of the surface and not that of the entire road upon which it is to be placed. Money expended in original construction of a permanent nature, such as drainage and foundations, must be regarded as a lasting investment, if properly done, which is too often not the case, and differentiated from that of the surface which must be renewed from time to time.

The general answer to the question which is to be considered is: Pay enough to obtain a road which experience has shown will serve under the conditions which it is called upon to meet. Such a form of construction for heavy travel cannot be obtained with inferior materials or for a low price. Service tests of roads subjected to similar conditions are the best criterion for guidance. They are the only means of determining the value of any form of construction. Time is, necessarily, an element in obtaining data of this

description. Tried-out forms of construction, and materials of construction used therein, are, therefore, the best evidence of how a road should be built in the future. Unfortunately, too often the proper lesson is not learned from such experience.

A justifiable outlay may be said, therefore, to be a sum which, when skillfully and honestly applied, will accomplish a result which is satisfactory from the point of view of economy and utility. It must be regulated by the traffic, and the expected traffic, which the road will be called upon to carry.

Individual cases should, of course, be treated in different ways. A main artery requires a type of surface corresponding to a city pavement, and such a form of construction will be essentially the most economical in the future. Any road surface affords very little service unless it is supported on a proper foundation, and eventually it will be more economical to construct this of Portland cement concrete than to temporize with the matter. Such a foundation may be looked upon as an investment which will give a return for a long period of years.

The secret of successful road construction, to meet heavy travel, lies in proper design, proper construction or execution of the design, and the use of tried-out materials, but, more than this, the economy of any method of construction is dependent largely on the manner in which it is maintained.

Little that is new can be said on the subject of bituminous highway construction, except to apply the conclusions derived from actual service tests, which are now, in some instances, about seven years old as relating to modern types, but a realization of the important points can only be accomplished by reiteration. Improper principles of construction are often inherited from the customs of previous years, and there is great difficulty in getting away from old and long established prejudices and specifications, and the desire to build the largest mileage for the least money. This is well illustrated, as examples, by experience in the paving of our city streets with wood and asphalt blocks. Although it has been demonstrated in England for years that a wood block should be placed directly on a smooth concrete surface and cemented thereto with coal-tar so as to prevent the entrance of water at the bottom of the block, the method of construction in use in this country which permits of the infiltration of water, is still employed. The same can be said of our asphalt block pavements which are so laid that there is no bond between the surface and the foundation, the result being that the blocks are badly displaced under our modern motor travel.

Work which has been demonstrated by service tests to be

satisfactory should be imitated if the best results are desired. Years ago, when the writer took up the construction of sheet asphalt pavements, the lines of procedure were based upon the study of those surfaces in various localities which had proved the most satisfactory.

The evidence derived from this study offered a basis for our modern ideas of how work of this type should be successfully done, and there is no reason why similar principles should not be applied to road construction. We should study those road surfaces which have given the most satisfactory results and the most adequate return for the money expended upon them and imitate the principles employed in their construction in future work. The most valuable inference can thus be drawn from past experience.

The greatest enemy of good road construction is the desire to get something at a price inadequate to meet the conditions imposed. Any expenditure is justifiable which is necessary to meet such conditions and give satisfaction. It is an economy in the end.

It has been stated by the Massachusetts Highway Commission that the cost of maintenance on the heavier traveled roads in that state has reached $1,000 per mile per annum. If the life of a road surface is assumed to be ten years it is evident that half of the sum necessary for maintenance during this period, if expended in the original construction, would be a true economy and one which would yield an adequate return. There is ample evidence that an additional expenditure of 10 to 20 cts. per sq. yd. for the original cost of construction of a road with the best material, will generally be found to give more than an adequate return in the reduction of the cost of maintenance during the period of the life of the road.

The greatest enemy of good road construction lies, without doubt, in original economies. The satisfactory nature of any form of road construction is not to be determined by its original cost, but is only demonstrated by the travel which it has carried during the period of its existence and the amount of service obtained from it.

In considering the economies of road construction to sustain heavy travel, the following points should be given careful attention:

(a) Permanent features of construction:
   1. Subsoil foundations.
   2. Drainage.
   3. Adequate foundations for the surface.
   4. Adequate lateral support.
   5. Properly proportioned thickness for the several courses.

(b) Surface construction:
   1. The use of materials and form of construction demonstrated, by previous experience and service tests, to

be satisfactory, and to give an adequate return for the money expended.

Experience has shown that danger in road construction lies in:

1. False economies in original design.
2. Bad or inferior workmanship.
3. Awarding the contract universally to the lowest bidder.
4. Unsatisfactory execution of the work due to lack of intelligent control on the part of supervising engineers.
5. Neglect of careful study of individual problems of construction and of successful work under similar conditions.
6. The influence of mercenary and political motives, and finally, and of most importance.
7. Neglect of proper maintenance.

In conclusion it may be said that the justifiable outlay for road construction should be based on the results to be expected as demonstrated by previous service tests of various forms of construction. It is a question of economies as well as of engineering, a question of how to get an adequate return for the money expended. This will not be attained by any of the cheaper forms of road construction in most cases. The passion for economy, which is so universal today, owing to the desire to build a large mileage of road with the money available, is plainly being over-done.

Thousands of dollars are now thrown away on forms of road construction which can give no adequate return for the expenditure.

CHAIRMAN MACDONALD: Mr. Hill has a very delightful way of impressing points on his audiences, and he never fails to do so. There is a little Bible injunction that comes to me at this time, "The whole world lieth in sin." Then it says, "What is that to Thee. Follow thou me." Now the point in Mr. Hill's story—I have known him twenty years—is to place the individual and personal responsibility on every one here and to show you all the influence that this meeting can have in shaping the future of road building throughout the United States. I am aware of how the one became a thousand. I only felt badly to think that there were so many people absent from our meeting who could have gotten a whole lot of good by personal contact had they came in here and made additional missionaries for the cause along the line which Mr. Hill so beautifully illustrated in his talk. Now we will proceed with the program. I am sorry to say that under the title, "The Merit System in Highway Work," we were to be favored by one of the brightest minds in this country to discuss that question, but

owing to the loss of his wife, Mr. Richard Henry Dana, who is the President of the United States Civil Service Reform League, was unable to be present. And so we will have to take the paper and introduce the subject by title, "The Merit System in Highway Work."

How to Take the Roads Out of Politics

By RICHARD HENRY DANA
President, U. S. Civil Service Reform League

For fifteen years civil and sanitary engineers, architects, physicians, superintendents of streets, chief librarians, heads of bureaus, etc., men of scientific or special training and executive and organizing ability and high profesional standing, have been obtained through the civil service examinations. This is possible because those "examinations" consist, not of the scholastic questions and answers used for clerks, but of inquiry addressed to the candidates and to those who have employed them as to what education, training and experience they have had, their achievements in life and manifestations of executive and organizing ability and power to get on with and handle men. This inquiry is conducted by the aid of appropriate specialists of high reputation. To the inquiry is added a thesis on the conduct of the work to be done and sometime an oral interview to ascertain personality. Such up-to-date methods form the clue for "taking the roads out of politics."

The chief motive that impelled civil service reformers to devote their energies to the adoption of the competitive merit system for government appointments was to diminish the power of the political boss by taking out of his hands the unrestricted patronage of appointive office. The so-called "spoils" system was not only injurious to the efficiency of the government, but it created an army of political workers, thus building up an enormous political "machine," active in politics all the year round and often opposing the interests and wishes of the people at large. Before such an army of trained, disciplined, well-generaled party workers, paid out of government funds, the ordinary citizen was as helpless as a mob in the face of a regular army.

What about the size of this army? Altogether, counting the federal service and that of all other branches of government—city, county and state—within the United States, the total number of persons is over eight hundred thousand, and the toal salary something like seven hundred millions of dollars a year. But for civil service reform this would all be an enormous political standing army, and this stupendous annual sum of money would be all used to influence primaries, caucuses, conventions and even elections. Hardly more than one-third of this army and salary is controlled by civil service rules and laws. The rest is in politics.

The improvement of the civil service was, at least in the

earlier days, considered more as a by-product than as the main purpose of the reform. This by-product has become more and more important as we have advanced. It has been proved officially again and again that the government work is far better done by fewer people when under the competitive merit system than before; for example, in the railway mail srvice, where careful records are kept, since it has been put under the civil service system more work is done per capita at more than three times the accuracy of the best record ever made before, and five times some of the others. It has also been officially computed that the saving in the federal service alone is about twenty millions of dollars a year.

During the first fifteen years of the merit system it applied mainly to subordinate positions, such as clerkships, policemen, firemen, bookkeepers and the like, omitting the laborers at one end and the higher officials at the other. We have been very slow in extending the system upward. We have extended it sideways, so that now we have civil service laws in nine states and about 250 municipalities; downward, unskilled laborers in the federal service and some cities are selected on a basis of age and relative physical condition, so that the laborers are taken out of politics and the public gets young, active and able-bodied men. As to its extension upward, we have made considerable progress, as I shall explain more fully further on; but for the present all postmasters with salaries over a thousand dollars a year; all collectors of internal revenue and their deputies; all collectors of customs and United States marshals, for example, are outside the civil service rules, and the same principle applies in the main to the civil service of those cities and states that have civil service laws. As a result, while we secure better subordinates, the head positions, in which the brains ought to be, are usually filled by persons without proper education, training or experience. This is not all. The more capable subordinates, finding that promotion to these higher places is shut off from them, soon get discouraged and resign from the public service.

Still further, while the boss has been deprived of a large amount of his patronage, he still keeps the best paid offices and, through his power over the heads of city departments and other high officials, is still able to give contracts, jobs and the furnishing of supplies to political favorites.

It is now one of the objects of the Civil Service Reform League to arouse public opinion so as to compel congress to allow the higher postmasters, the collectors and the like, to be put in the classified civil service, so that such places may be filled by promotion and in general extend the law upward and thus to take contracts out of politics.

I shall now come to the application of the general principles of the reform to the experts in road construction.

What is the condition of road construction as we see it within the United States? Is there not a great proportion of the work in the control of incompetent persons? Even where good road experts are employed, is there not constant interference by their superiors to give contracts as political favors, to enforce too rigidly or not enforce at all the specifications for political reasons, and to do superficial work about election time to deceive the people into thinking that a good job has been done at small cost?

Let me state some of the advantages that come from the employment of experts in road construction. It will save waste from poor plans, poor methods, use of the wrong materials, improper or insufficient sub-drainage, or surface drainage, insufficient foundation, waste in the supervision of labor, loss from insufficient specifications and from failure to enforce good ones properly, the lack of proper super-elevation at curves, causing great wear both on the roadbed and the tires, and the employment of incompetent laborers, employed to give influential voters or friends of active politicians a job at the expense of the public at high pay, and the inability to get a day's work for a day's pay from those otherwise competent men who know that they hold their job not for what they do in road building, but through the political influence of the party boss behind the throne of the road authorities.

The experts, especially the chief experts, hold their office as a rule, do they not, at the pleasure of political superiors or superiors who themselves, though not active politicians, may be removed for party reasons, or are themselves elected officials who look for a re-election, which may depend more upon satisfying a political boss or packing a primary than upon securing good roads for the public; and is it not also often true that the position of the expert is needed to carry out some party plan or complete a factional slate? At all events, the employment is so apt to be temporary and the changes are so often made, even when good experts are employed, that continuity of policy is not carried out. Fear of removal and the desire to help those who have given the appointment tends to bring the expert into politics. No permanent career can be offered to younger men who enter from the lower grades of expert work; no hope of promotion to the upper, and as a rule it is hard to get the men of the best ability to leave well-established work with private persons or corporations for the uncertain and sometimes distasteful work of public employment. It sounds more funny than fiction when we read the truth from the report of James W. Osborne, special commissioner to investigate the New York state highway department, that the

inspectors to pass on contract work were some of them barbers, tailors, prize fighters, bartenders and bakers, and, as might be supposed, that their inspection "was totally inadequate."

But, even supposing that the experts from top to bottom are apopinted absolutely free from political favoritism of any sort and are men of good ability, their powers are limited. To be sure some road commission, for the time being, here and there, may be found that will not interfere with their experts, but as we have seen again and again, the experts are subject to the direction of the non-expert, political or semi-political boards or elective officials, and have to submit to the superior authority which can put a joker into a contract, modify the specification, order poor work to be accepted, or good work to be refused on the payment or non-payment of political contributions or the possession or non-possession of political influence.

As an illustration we have the case of the New York state road construction, and nothing was more evident in the investigation than that in many cases the experts were entirely opposed to the action of their superior officers, which they had no power to prevent, and it was contrary to official discipline to expose to the public the various methods that were used for giving contracts to influential politicians, or for securing political contributions at the threat of holding up pay for work done.

But some one will say, if we leave road building wholly in the hands of experts with independent tenure of office, we are not having local self-goverment; we are interfering with the representatives of the people and choking off the expression of public policies. We must admit that if we should make our experts complete despots that there would be a great deal of truth in these objections. Can we not, however, find some line of demarcation between the two extremes? I think we can. The representatives of the people, the policy determining executive or board or legislative body should decide upon the general public policies as to the amount of appropriations, just where good roads are to be built, as, for example, between which towns and cities, or what general principles of choice are to prevail, but, on the other hand, the powers of the experts should be supreme in the operative sphere as distinct from the policy determining. The operative sphere should include the full control of the preparation and award of contracts and the enforcement of specifications; the control of labor, and the purchase of supplies, and everything else that is necessary for securing the best results at least cost to the community. The community should have a right to say how much they will be taxed. and what it is they want done; but beyond that the

community will get the best results, will it not, if it will leave to experts, selected without regard to politics and free from the danger of political removal or interference in any way, the carrying out of the details of the plans necessary to accomplish the purposes the public has in mind. The experts, too, should be allowed freedom to advise and even educate public opinion as to public policies within their specialties.

We then have to consider the three chief points: First, the selection of experts which will secure from top to bottom experts of ability, experience and character; and, second, tenure of office during capacity and good behavior; and, third, ample powers within the operative sphere. Now for the selection of the experts in any large public service devoted to road building. There should be a system of promotion from among the assistant engineers and other experts that would secure the highest positions when vacancies arise to those who have shown the best ability and achievements, and entrance to these lower positions should be through civil service examinations. Where there is not found among the subordinates any one suitable for promotion, or where the service is new, then it is necessary to go outside. And in such cases there ought to be freedom to select experts from all parts of the country, and ample inquiry into the sufficiency of education, training, special ability, and the possession of organizing and executive faculty among the candidates. Now, how can this be done? The adoption of the civil service system would secure promotion, but no open competitive examination composed of written questions and answers of the "scholastic" kind would ever be suitable for the appointment of the chief experts in any such undertaking as modern road building on a large scale, but when I have said this it does not mean that the experts may not be still selected through civil service methods; for the civil service methods are not confined, as too many persons take for granted, to the written scholastic examination conducted in the same room and at the same time, such as are used for the selection of clerks, bookkeepers and the like. Every method known to business for the ascertaining of the relative ability of various candidates that is capable of being systematized—that is, every method excepting that of pure favoritism—can be and is employed by civil service commissions. Bench tests are used for selecting mechanics; physical competition for policemen and firemen; saddling, mounting, riding horses and firing from horseback have formed part of the civil service examination for United States rangers. For the last fifteen years men of high organizing and executive ability, power to handle subordinates and get on well with men, combined with appropriate scientific knowl-

edge, have been secured for high governmental positions by what is called the "unassembled investigation of careers" conducted by civil service commissions. Though this has been in operation for fifteen years, as I have just said, its existence is still unknown to many experts, statesmen, and, I may say, to the great majority of our citizens, and it is largely for explaining this method of selection and showing its applicability for the choice of experts in road building that this paper is written. Let me give an illustration:

The office of librarian of the enormous library system of the city of Chicago became vacant. It was found that that position was classified under the civil service rules. The first idea was that an exception must be made and the appointment authorized at the discretion of the mayor, for the reason, as stated, that it would be impossible to fill the place satisfactorily by any "scholastic" examination. The civil service commission and the civil service reformers of Chicago were well aware of this "unassembled investigation of careers" and how successful it had proved, and they undertook to make the selection under the civil service rules. First of all, advertisements were sent out over the country and especially to all the journals devoted to library work, and letters were sent to library experts to suggest candidates. It was explained that the examination would not consist of the ordinay sets of questions and answers, but that each candidate should reply from his own home or office to a detailed inquiry as to his education, training and achievements in life. Then three eminent librarians were chosen to aid the civil service commission in this investigation. The three chosen were Mr. Herbert Putnam, of the congressional library, Washington, D. C.; the head of the Crera library in Brooklyn, N. Y., and the librarian of the University of Chicago. These men aided the civil service commissioner and their chief examiner in drawing up the questions on the experience sheets sent to the various candidates. The candidates were also asked to send in any book, pamphlet or paper prepared by them on library administration or kindred subjects and to give the names of persons for whom they had worked, who would know of their successful administration. Then, after weeding out those who from their own statements were manifestly unfitted, there were sent to these former employers searching questions, which were answered in detail, showing any facts tending to prove the possession by the candidate in question of executive and organizing ability, any unusually successful work accomplished, the possession of such temper and manners as would enable the candidate to get on with other people, and the ability to handle subordinates to advantage. Each candidate was also asked to prepare a thesis on the management of the Chicago library system, and to aid him in understanding the situation

he was furnished with the latest official reports of Chicago relating to the library and the municipal budget and resources. These theses were prepared at the homes or offices of the candidates and sent to the civil service commission. As a result of all this investigation and the examination of these records by this jury of three great experts, Mr. Laegler was put first. As the civil service records, thus prepared, showed, he had been librarian at the Wisconsin University; had there instituted some methods of library administration of such value that they were being copied by other libraries all over the country; had, when in another capacity, practically organized the splendid university extension work and public aid given by the University of Wisconsin; had gone before committees of the legislature and explained his methods and secured appropriations; and had been able to train his subordinates so as to get the best possible results. Indeed, as Mr. Putnam said to me, there was no better man that could be found in the country not already occupied in some better position. In some of the non-assembled investigations the candidates are questioned orally by this expert examining board and further graded on personality.

Now let me call your attention to one or two matters: Through this method there was secured what every appointing officer should secure, that is, a thorough investigation into the capacity of all the candidates, but a kind of investigation carried out with a degree of thoroughness that we know is not exercised by appointing officers, even when they are free from any political motive and desire to secure the best results, not even by most business men or corporations. Indeed, the art of appointing the best from a large number of persons for responsible positions is, by no means, as simple a one as many people suppose. Again, under the civil service system, all the evidence on which the selection is made is a matter of records, so that at any time the grounds of selection may be reviewed—an effective guaranty against favoritism—and the appointment is made without the appointee's being under obligations to any party, party faction or political boss; and, finally, when once appointed in this way the tenure of office is practicaly secure, because the motive otherwise existing of removing an expert, namely, to give the appointment to a favorite, has disappeared, for the appointment of a successor must be made in the same way that the original selection was made, or else by promotion from a limited number of persons who have secured their positions by open competition. Then, again, when the position is thus put under the civil service system and the tenure of office is secure, instead of keeping able men away, it is found by experience that it has attracted them. It has commonly been said that you can not get able men to enter the

civil service examination, but, in the words of the United States Civil Service Commission commenting on the results of such civil service investigations in its twenty-ninth report:

> "Examinations of this character have been found to attract men of the highest type. A belief in many quarters that no distinguished expert or person of high professional or scientific attainments will compete in a civil service examination is a fallacy."

This has also been the experience of municipal and state civil service commissions that have tried the system.

At a hearing of the legislature in Massachusetts on a bill to allow heads of departments to be selected in this manner Professors Swain and Sedgewick of the Massachusetts Institute of Technology said that they usually advise their graduates not to accept public work, because it is so mixed with politics; but, should these position be put under the civil service system and carried out in the way above explained, they, on the contrary, would urge all their graduates to enter this kind of public service.

Another objection has been made that there are not sufficient experts in the country to fill all the positions in the road construction that is going on. However that may be, we can secure all the experts there are who are willing to undertake the work, and if one will just read the catalogues of the leading universities of the country he will see that more and more time is given to the education of experts in all kinds of municipal and state undertakings, among which road building is one of the most commonly taught. The supply of young men who can be put in the lower grades of expert work and make their way up, through promotion, is very great.

Some objection is raised, on what is really a priori and theoretical grounds, that experts with tenure during good behavior and capacity would not accept new policies. In practical operation exactly the opposite is found to be the case. Not only do such experts take kindly to new policies, but they are foremost in suggesting and urging them. The expert is far more well informed as to new devices adopted in any part of the civilized world and to weigh the merits of them than the non-expert.

I remember, not long ago, delivering an address before a club of business and professional men as to the application of the merit system to the selection of high-grade experts. I saw one prominent man before me with his face set in stern disapproval from the beginning. After the address he made the remark that "it is absurd for anyone to suggest selecting men for such positions by a scholastic examination of questions and answers," and wondered that "a man of my position should advocate it." The truth was this gentleman

had shut his mind up into idea-tight compartments, proof against the percolation of a new thought. It is this state of mind which prevents many people from examining into the civil service method which I have just now laid before you.

But, after all, the best proof of the pudding is in the eating. If this were all a matter of theory which had never been tried before, or perhaps only in one or two instances, I should blame no man for considering it highly theoretical, just as old sea captains and river steamboat navigators thought it was impracticable to cross the Atlantic Ocean in a vessel propelled by steam. Should any such captain continue so to think after the ocean had been crossed many times every year for fifteen years in succession with success and improved speed and economy, ought not that captain to be considered antiquated indeed? So it is with anyone who doubts the applicability of the civil service system to the selection of engineers, unless he is absolutely ignorant of how often we have crossed the ocean of spoils politics in safety by the advanced methods of the merit system.

The first position to which it was applied, about fifteen years ago, was that of the supervising architect of the United States, a position of the very greatest importance and high salary. Then it was applied to the selection of the heads of many of the bureaus, especially those of the Agricultural Department, for which positions men of high scientific education in their specialties and executive and organizing ability were required, and the success with which these departments have been established and carried out under experts selected in this way is the best proof of the applicability of the system. Among other positions I may mention that of the head of the United States Bureau on Road Building and Road Materials.

In the city of Los Angeles the enormous water supply that was to cost many millions was put into the hands of engineers selected in the ordinary way. The work was going to pieces, little was accomplished and an enormous amount of money had been wasted. Then the board in charge was reorganized and all the engineers from top to bottom were selected by the civil service system, and after that the work was accomplished rapidly, economically, without taint or fraud, and with the most complete success.

Even assistants to the attorney-general at Washington and assistant solicitors and attorneys in states have been selected in this same way; also the chief engineer of the city of Chicago, engineer in charge of bridges, city auditor, the chief street engineer, the building inspector in chief, and numerous other officials with salaries from $5,000 to $8,000 a year, and lately in Philadelphia the chief engineer and his assistants for the new subway development and other experts,

with salaries even as high as $10,000 a year, the heads of departments, with one or two exceptions, in Colorado, the secretaries and chief examiners of civil service commissions in several states have also been chosen by this same process.

The division engineers in the state of New York who are required to have charge of the construction, reconstruction, maintenance and repair of state and county highways are now under the civil service system, with the full approval of the commisioner.

In Kansas City the chief engineer, the assistant chief engineer, the superintendent of streets, and some other positions have been appointed through competition, and in New York City the merit system has been expanded to cover the position of chief engineer of the Board of Estimate and Apportionment.

Indeed, these are only some of the many examples which I could give you. In addition to that, I may quote Lieutenant James Reed, assitant director of the department of public works of Philadelphia, in a paper read at the last meeting of our National Civil Service Reform League. He not only commended this method of selection as having worked with perfect success, but he also showed and proved that by this method of the selection and retention of experts the municipal contracts had been taken out of politics in Philadelphia—that city long known as being under the domination of political contractors.

Some objection has been made to the merit system because of an alleged difficulty in removing a classified employee. We claim that it is generally easier to remove for good cause under the merit than under the spoils system. Under the spoils regime an employee put in by political influence often could not be removed by his official superior even for drunkenness and insubordination. The superior who tried to remove him would usually find him reinstated, or his own official head in danger of coming off. It was easy enough to remove after a change of party or party faction—too easy, for both good and bad were turned out. It is only in the New York City police force that removals for cause are difficult. There, against the opposition of the national league and the New York Civil Service Reform Association, an appeal to the courts with a complete revision was allowed, but elsewhere the usual rule requires only a statement of the reasons for removal in reasonable detail to be given the employee, with a chance to answer in writing, just to avoid removal under a mistake as to the facts, but the appointing officer has the final power.

Fixing of the powers of these experts is a matter of legislation and not of civil service reform, but, at the same time, the selection and retention by the civil service method will

give them such independence of position, such freedom from any question as to how the next election is going, and such absence of control by politicians that any powers granted to them by law can be exercised with an amount of independence which would be impossible without the tenure that the civil service system gives them.

It is true that some of the experts in German cities, in the city of Paris, and in the cities of Great Britain are not strictly under civil service rules, but they are under restricted methods of selection, partly from custom and partly by statute law very closely allied the system that I have just explained, based on competition and the possession of education and experience that produces practically the same results by methods which are first cousins to the civil service system, and I need hardly say how vastly better and more efficient is municipal administration in those municipalities in which all the operative work is in the control of these prominent, highly trained and efficient experts.

In the national government of Great Britain all the experts of that board that has control of municipalities called the "Local Government Board," and the permanent heads of all the great national departments, such as the Treasury, Post-office, Foreign Affairs, and the like are strictly under the competitive civil service rules.

It is important that the civil service commissions should themselves be free from political considerations. Besides having their chief examiners, secretaries, and other subordinates under civil service rules, the plan of having the civil service commissioners appointed for long tenure, say, six years, with overlapping terms is recommended and in some cases already adopted.

Lastly, may not the plan of having all the governmental work in the control of high-grade experts, free from politics, be the final solution for securing efficiency and economy in public undertakings? May it not be the anti-toxin for public waste and corruption? May not the great success of the United States Army engineers in the harbor and river work and in the Panama Canal be because these army engineers are so free from political pressure and have so secure a tenure of office, rather than because they are superior as individuals to the civil engineers of our country?

If there be any truth in these ideas, is this not a cause well worth promoting with all our influence, patriotism, and enthusiasm, not only in road building but in all other governmental enterprises?

CHAIRMAN MACDONALD: We are very nicely adjusted in our loss in having the discussion opened by one of the brightest minds that we have in our road building councils, and that is Dr. J. H. Pratt, who is the secretary of the

State Highway Commission and State Geologist of North Carolina, who will open the discussion under this topic. (Applause.)

Discussion by Dr. J. H. Pratt

Mr. Chairman, Ladies and Gentlemen: In opening this discussion on the subject of "The Merit System of Highway Work," I am doing so without any reference whatever to Mr. Dana's paper, as I have had no opportunity to read it or know upon what line he would treat the subject—except knowing the position he holds under the United States government, that he would probably treat it from the civil service standpoint. At first glance we are apt to think of this subject as applying simply to civil service appointments and inaugurating in the state the civil service method for governing all appointments. I am not, however, considering the subject purely from this standpoint.

I am thoroughly convinced that a merit system can very profitably be made applicable to highway work in any state, and in such a manner that it will permeate the whole road work from the highest official to the cheapest laborer. There are certain fundamental principles, however, relating to road construction and maintenance, that must be recognized by the people of a state before any satisfactory results can be obtained. First, that the construction and maintenance of our public roads must be considered as a purely business proposition. Second, that satisfactory results can only be obtained by having experienced men in charge of the work. Third, that the road work can not be used as a political football, and the road forces used as a medium for paying political debts, and at the same time the people get a satisfactory expenditure of their money and a good system of roads. It may be that in my treatment of this subject I shall seem to depart somewhat widely from it and to discuss certain subjects that have been assigned to others, but I beg their pardon, because in doing this it is only to be able to emphasize more fully certain points of my own subject that I wish to bring out.

As a business proposition it seems to me that it is necessary that we should consider our subject applicable to the very beginning of a road organization, namely, the members of a highway commission. This commission should be as far as possible non-political and made up of men who are interested in the road work of their state, and so appointed that only a certain percentage of their number shall retire at one time. And this commission work shall have a similar relation to the highway work that a board of directors has to the work of its corporation. In some states the members of the highway commission are appointed directly by the governor of the state and represent the state at large. In

others, they have to be appointed from certain districts of the state, so that each section of that state shall be represented on the commission. Members of the commission are sometimes designated by the general assembly of a state. In certain instances they are members of a council of the state; in others they are professors of civil engineering in the state university, or the college. In other states it is a combination of both such appointments. In several states the personnel of the commission is so regulated that at least a certain percentage must be of the minority political party of that state. Now, these varied methods of forming a highway commission have to my mind been brought about undoubtedly by the people beginning to realize that their highway commission must be appointed or made up solely in the interest of the highway work of the state. As the people realize the necessity of this and demand it, they can and will obtain the kind of a commission they want. The term of service of such commissioners or members of a highway commission should be of sufficient length so that they can become thoroughly acquainted with the needs of the state in connection with highway work, and it seems to me that in all commissions no member of the commission should be appointed for less than four, and preferably six or eight years. To the commission should be given the authority over the state highway engineers or state highway commissioners, as they are called in some states, for with a commission as outlined and being demanded by the people of a state, much better results will be obtained by the appointment of the engineer than if he is appointed by the governor of the state whose term of office in many states is only two years. To the commission should also be given the authority to designate the salary of the state highway engineer and all other employees.

With this authority the commission is in position to obtain the services of an engineer who is in every way qualified to fill the position required. He must be a man of wide experience in highway work and also have executive ability. I believe that such a commission will appoint the state highway engineer on account of merit and not for political reason; on account of worth and not for favoritism. The length of service of the engineer should be determined and will be determined in cases of this sort by merit and what he is able to do. But I think it is well that the engineer should be retained for a certain, definite number of years, if we are going to be able to get the best sort of engineering staff for this sort of work; but I do not believe it is as important that the engineer himself at the beginning should be hired for a certain definite number of years as it is that the members of a commission should

hold their positions for a series of four, or, to my mind, even better, eight years. The value of such an engineer to the state obtaining his services rapidly increases with the length of service, and therefore it is to the material advantage of the state to retain the services of such a man; and the engineer must have some assurance that the character of his work will determine his length of service.

When the engineer is appointed by the governor there is very apt to be a change of engineers with change of governors, particularly if there is a political party change at the same time. With the appointment by a commission as outlined above, where their tenure of office is from four to eight years and they don't all go out at the same time, there is but little chance of change of state highway engineer even when there is a change of political party. For comparison, many state universities are governed by boards of trustees appointed by the general assembly or by the governor and these boards elect the president of the university. We do not expect such a president to be changed because a new governor has been elected or because the other political party has come into power. Why cannot the same procedure be expected in the appointment of our state highway engineer? I not only think we should expect it, but we will have it. The people of a state would not stand for the change of our president of the university because of the political change in governor, and the people are not going to stand much longer such changes for the state highway engineer and similar officers.

The people will dictate when aroused and they are now dictating that political changes in governor shall not cause changes in our highway forces. The state highway engineer should be entrusted with the selection of all others who are to carry on the road work of the state, and their appointment, of course, will be subject to the approval of the commission. This again is in accord with the procedure that is in connection with our state universities, where the president selects with the approval of his trustees the professors, instructors and others connected with the force of the university.

Again, the state highway engineer must have authority to discharge any and all employees connected with the road work. Many a state highway engineer today, I am sorry to say, is handicapped in his work by having in his department men who are inefficient, but for political reasons must not be removed from office. This is wrong and is not fair to the engineer; and also it is decidedly not in the interests of the state. In the selection of his assistants the state engineer must of necessity obtain such men as are qualified to do satisfactorily the work required of them, and being in a position to assure them that their length of service

and remuneration will be dependent upon their ability and development, will enable him to secure a higher class of men for the work. An assistant engineer who continues in the service of the highway engineer should become more and more valuable to him and the work of the state and if he does not develop in this way his service either will not be needed or he will be retained with no advance in salary.

Permanency of employment of road officials is unquestionably in the interest of economic road building, while a constant change by a state of its highway engineer is to be deplored because it will usually mean a contant change of policy instead of a continuing and expanding policy; and it is most disastrous to state road work for the road forces under the engineer to be constantly changing.

In this connection compare the work of the state of Massachusetts with a continuing policy with the road work in New York state with a changing policy, and we will find that the result of the work accomplished and the roads built is all in favor of the state of Massachusetts. The merit system is not only applicable to the engineers, but to superintendents, foremen, and in fact every man on the job. A superintendent's value is dependent upon how successfully he can follow out and carry out the instructions of the engineer and handle his construction and maintenance forces; and this latter will depend largely upon how wisely the superintendent has selected his foremen who are in actual charge of the laborers. It is practical for the engineer to keep in close touch with all construction work, so that by means of a system of cost accounting he will know accurately the value of each foreman; and if a certain foreman is not obtaining similar results in the same kind of work and with similar equipment as the other foremen then he is not the man for the place. I could cite instances where counties have saved thousands of dollars from the fact that the engineer was able to know what his superintendents and foremen were worth to him, and on the other hand we have instances where counties have undoubtedly lost as much as fifteen thousand dollars out of a bond issue of two hundred thousand dollars by not keeping an accurate cost account or knowing the value of the foremen and superintendents of the road construction work. The men under the foremen and superintendents, realizing that their employment is dependent upon this, and that if they make good their employment is practically continuous, will give better and better results the longer they continue in the service of the engineer and consequently are of more value to him. Are they therefore not worth more money and is he not warranted in paying higher salaries?

In my own state, North Carolina, we are inaugurating a system by which our better superintendents and foremen are constantly at work, and we do this and have been doing it for some time by having arrangements made by which we transfer them from one county to another county and even from township to township; and we are now in such shape that we command the services of the best men of this work throughout the whole state. When our road men realize that merit will count we are then in a position to get the best results and are able to give our men the best of encouragement in regard to their future services.

It may be that I have been outlining perhaps too much of an ideal in regard to the merit system of road work, but I do know that it is possible to have passed laws that will enable us to carry out to a very large degree what I have outlined.

In North Carolina it is only within the past year that we have established the state highway commission. Previous to this year the state work has been done under the geological and economic survey. We have had passed there a law governing the state highway commission which I have outlined in connection with what I speak of as the merit system in the road forces, and we believe that following out the ideas in that law we are going to be able to get much better results than we possibly could in any other way. (Applause.)

CHAIRMAN MACDONALD: I know that Dr. Pratt will be very glad to answer any questions that you would like to ask and I wish the delegates, as these papers are read or the discussions take place, would fix upon some particular thought in which they are interested and just hold that thought until the paper is through and then give the other delegates the benefit of that thought by asking that question. I many times have delivered a talk and after I had concluded, although I had opened the question box and had gotten down into the audience, someone would come and ask me a question, a vital question. I would say, "Oh, my dear sir, why didn't you ask me that question when I was on the platform." It was such a splendid question and it would have done such a world of good and shed such light upon that particular subject. Now, don't let us go away with that proposition to contend with. If you have got a thought in your mind, I don't care how simple it is, someone might have a question in their mind and they are afraid to ask it. Just put it down in your mind or on a piece of paper and feel free to ask it. I know that Dr. Pratt will be very glad to answer any questions in regard to his valuable paper. Some of your states that have not entered into this movement at all can

get many good points from Dr. Pratt's talk, because he has completely covered the ground, and I know he will be glad to have developed some thought in your mind.

If there are no questions to be asked we will take up "The Determination of the Justifiable Outlay for Specific Cases of Highway Improvement," the valuable paper that Mr. Hill read. Mr. Clifford Richardson came all the way over here from New York City intending to present his paper himself, but he was taken with a very severe cold and it so interfered with his being heard that he wanted to present the paper and simply have it incorporated in the proceedings, but it was such a valuable paper that we thought we better have it open for discussion, inasmuch as we had with us Mr. Henry Welles Durham, who has had charge of that great construction area known as the Borough of Manhattan, New York City, as chief engineer of highways. Having heard that paper read by Mr. Hill you will all be very glad to have Mr. Henry Welles Durham take up the question and develop the thought. I take great pleasure in introducing to the delegates Mr. Henry Welles Durham, formerly chief engineer of highways, Borough of Manhattan, New York. (Applause.)

HENRY WELLES DURHAM: Mr. Chairman and Gentlemen: When I was asked to contribute to the discussion of this valuable paper of Mr. Richardson, I was told that the discussion would be on the subject and not on the matter of the paper, and I was not furnished at the time with a copy of Mr. Richardson's remarks. After hearing Mr. Richardson's paper read and after I had written my few remarks on the subject, and also had a chance to see what he had prepared, I was somewhat nonplussed, like the London cab driver who was asked why he didn't answer the other fellow back, when he said, "How can I? He has used all the best words." (Laughter.) I looked over my remarks and found that a few of them had better be cut out, they having been better expressed by Mr. Richardson. But from my experience in a slightly different line from his I wrote down a few thoughts on the subject which, as he very well says, forms a whole treatise in itself, and in a few minutes can only be briefly touched on.

The Determination of the Justifiable Outlay for Specific Cases of Highway Improvement

By HENRY WELLES DURHAM
Consulting Engineer, New York, N. Y.

In any given case, whatever the class of road considered, our maximum possible expenditure is limited by the means of the road purchaser—be it private individual or corporation, town, country, city or state—and all expenditures beyond this limit however desirable fall outside our considera-

tion into the realms of abstract theory. Again we are confronted by what may be termed a minimum possible expenditure worthy of consideration which may be taken as the value of the annual damage or maintenance caused by the existing traffic in our assumed case, to a road surface adequate to carry it, plus the value of financing its original construction. Between these limits, if we have a positive difference there is room for engineering study—if negative the engineer must await the work of the doctor of finance and the end of hard times.

Our discussion must be based on the assumption that the investor in roads is in sound condition and able to pay for what he needs to allow of the proper development of his territory. As engineers, true to our traditions, we must provide that which will do the work required at minimum cost and therefore the variation between our assumed limits of range of justifiable outlay is actually zero, for no individual or body, however rich, should afford, economically considered, to pay more than actual value for needed improvements.

Our problem, therefore, is, in brief: What is the road which will best serve conditions encountered in this particular case? Its solution must be reached in exactly the same way as is done in planning work in other lines of engineering. Particularly does the work of the railway designer furnish a parallel for the proper course for the highway planner. On a large railway system when a particular improvement is planned, what is the course followed? Is it like that in many cases of highway work in our country? If so, those in charge of the suggested branch line, extra siding, low grade relief line or cut-off would study the problem before them as an original unit. They would take a vote of the villagers on the type of track construction to be employed. Careful specifications for rails and ties would be worked out from original studies and time would be spent on the decision as to a suitable track gauge and bridge clearance based on local traffic studies. As a matter of fact such was often the case in the early days of the railroad, but as individual lines gradually became parts of great systems it was seen that planning for parts must be done with the whole in view—that proper coordination required a design working from the whole to the part rather than in the reverse direction.

It has long been recognized in the most progressive foreign countries and recently in some of our states that highways must be planned in the same way as parts of a great system properly coordinated and inter-dependent and not as specific units. No matter how small may be the particular case of highway improvement under consideration the justifiable outlay cannot be considered as having been properly de-

termined if it is studied only by itself. Not only is each road or street merely one of the elements of a large system, but the traffic which determines the type of improvement adopted may itself be altered by the solution it suggested. Our problem is incapable of an exact solution, having an excess of variables. To arrive at the approximation to exactness which is the most we can hope for there must first be determined not only the present day traffic for the route in question, but also the probable traffic at the end of a period assumed to be the useful life of the surface which will be selected. In other words, our result is only obtained by a series of trial solutions with two large unknown factors to be assumed.

Our methods can have little of the exactness of the bridge designer and use more assumptions than the formulae of the hydraulic engineer. Fundamentally all correct highway design must depend on the old economic principles which are sometimes forgotten but never superseded.

1. We can get no more (though we may have less) than equivalent value for our expenditures great or small.

2. Service or life of any human piece of construction is inversely proportional to the extent of its use.

3. Permanent construction is impossible.

Much time and ingenuity have been expended unsuccessfully in attempts to controvert these facts.

While the fact that roads must be considered as parts of a system is known to those charged with road design and maintenance, there is less recognition that in our municipalities the question is essentially the same. Although city planning gradually has been given consideration, the term is restricted by most to the actual laying out of a city map, with routes of circulation and civic centers, and so-called city planners have based large reputations on attempts to adopt the map of Paris or Washington to our towns and villages.

Too few thus far have followed the matter farther, but the decision as to type of surface employed on any city street should be only the last detail working down in regular sequence from the city plan. In an ideal city we would have development districted, providing definite classes of traffic for different streets. Pipes and other subsurface structures would be planned and built with an orderly arrangement and a future capacity that would reduce to a minimum the need of making openings in the pavements and hence would allow the latter to be planned with a view to their wearing out under wheel traffic rather than to suffer destruction under the pick and crowbar, and this would mean that for each street the class of surface most suitable for the conditions to be encountered would be planned throughout the entire municipality. When the question of expenditures for

improvement on a particular unit came up for solution the justifiable outlay would have but one variable factor: What is the extent of surface we wish to construct at the present time? It must be freely conceded not only that this ideal exists nowhere, but that it probably never will.

Let us go to the other extreme and briefly review our present American municipal method of settling our problems and see where it can be improved. Assume a growing district well within the city limits but only recently having had its streets and lots graded and the necessary street mains laid. It is well supplied with nearby public transit lines and its real estate owners are rapidly developing it for apartment houses and stores so that it will soon be solidly built up and require that its streets have a permanent pavement for moderate traffic which in a few years may be heavy. Let us grant that instead of being laid out as best suits the particular developers of the district in question, its plan has been properly interlocked with that of the city as a whole. The necessary legal steps are then taken to start the work of paving the streets by the municipal authorities at the expense of the properties benefited.

Here we have our municipal highway department confronted with the problem that forms the subject of our discussion. But is it solved by such a discussion, by those qualified by experience to decide just what shall be the justifiable outlay to be encountered? Perhaps, sometimes. More often those paying the assessment claim the right to decide what shall be bought. Superficially this seems reasonable. Actually it is absolutely wrong. The taxpayers foot the bills for water supply and for sewers, but assert no right to a voice in the expert work of design. Their ability is no greater to select a pavement with wisdom, perhaps it is less, but because it is under everyone's foot and forms his closest means of contact with his municipal government no citizen is too ignorant in his own estimation to decide the question of suitable street wearing surfaces and their relative values and costs. Nor does presumed intelligence and high standing in the community bring with it either wisdom on this subject or in its place deference to expert knowledge. The elected executive head of one of our communities of over 2,000,000 inhabitants after presiding for an hour over a discussion between his highway bureau engineers and representatives of certain paving contractors betrayed inadvertantly his comprehension of the whole subject by a casual remark indicating his belief that sheet asphalt pavements were rolled up like carpets and relaid as an incident to maintenance work. And, ignorance is not the only difficulty. One of our municipal subdivisions has for years shown a fondness for one class of pavement in its newly laid-out districts hardly explicable as due to a deep seated conviction on the part of a

community of paving experts. As the surface in question costs more originally and is harder to maintain subsequently than another type seldom favored and as only one bidder ever takes contracts on the preferred material while on the other the field is open, the conviction becomes strong that the signers of the petitions have been subject to commercial "acceleration."

Examples like this could be multiplied from the experience of all who have had to do with highway construction. We may not be able nor might it be desirable in a world of ordinary mortals, to bring about a Utopian municipality where everything is perfect and there is no farther incentive for the ambitious striver after the unattainable. What can be accomplished and is on its way now to accomplishment is the attainment of a willingness in our communities to place expert problems in the hands of experts for solution, to concentrate authority and with it to demand responsibility, in fine—to take our technical departments and their workers out of politics.

CHAIRMAN MACDONALD: Now, gentlemen, who is going to be the first one to ask some question in regard to this very important matter? Perhaps you have no politics out here.

MR. KENYON: Just to illustrate one of the points that I experienced once in Paris. I stopped to ask a property owner what kind of an improvement that was that they were putting down. It was in the evening. I asked him what kind and what was the cost. He said, "Why, I don't know. You must go to the engineer, the experts, they will tell you about that." I says, "What? Do you mean to tell me that every property owner and taxpayer in this block and along this street don't know what kind of a pavement this is and what it costs and had his hand in deciding what kind should be put down?" He says, "Why, no. We leave that to the experts." I said, "Over where I live in America the property owners along the street get together, or separately, and each one is in favor of one kind or another, and in that way they decide what kind of a pavement they should have." He says, "Is that so? Are they as smart as that in America?" (Laughter.)

CHAIRMAN MACDONALD: Brother Kenyon, you started in fine. Now, has any other delegate got a little incident?

MR. TERRACE: I want to take exception to the brother from Indiana. Sometimes experts don't agree. I was on a jury a little while ago. We were condemning for the Lake Washington canal for the government. Among other things there was a water system that was going to have to be condemned. The county hired two experts and they

came in. They had analyzed all the ingredients in that water. They pronounced the water bad, not fit for human use. The company had their two experts. They had analyzed the water—every ingredient in it—and they brought in a verdict of good, pure water. Now, there the experts couldn't agree and it was up to eight ordinary farmers and four laborers to decide that question. We decided this way. We will go out there and we will drink the water ourselves and we will take it home and we will boil it out and we will make tea and coffee of it and we will bring in a verdict according to our finding. We did it and we pronounced it good, pure water. (Laughter.)

MR. GASH: This question of the experts agreeing reminds me of a circumstance that happened in Utah a few years ago. Parley L. Williams is one of the best lawyers I ever saw, a highly cultured gentleman, as some of the delegates here well know. They were having a great mining suit and during the procedure after the facts were all in each side brought in their mining experts as witnesses. There were many thousands of dollars involved in the law suit, and these mining experts as witnesses differed very materially. The point of the story is that when it came to the argument Parley in his beautiful way said, "We have three different kinds of liars. We have the ordinary liar; we have the damn liar, and we have the mining expert." (Laughter.)

CHAIRMAN MACDONALD: That was really nice and enlivened the occasion. Now we will see what we have here for the next subject. "Convict Labor for Highway Work." We have a paper here by G. P. Coleman, state highway commissioner of Virginia. I think Mr. Coleman is not here. Mr. Willoughby, will you kindly read his paper. It is a very important matter. States are thinking about this very seriously and I think we had better have this paper read. Mr. Willoughby suggests that while reading the paper he will be very glad to stop and explain the particular paragraph he has just read as far as he is able.

Convict Labor for Highway Work

By G. P. COLEMAN
State Highway Commissioner of Virginia

The first reference I have been able to find of criminals used in highway construction in Virginia was from a pamphlet published in 1848. These prisoners were hired out to the contractors, I suppose by the state, since I have not been able to find a law on the subject. They were fed and guarded by the contractor, who was also required to give a bond for the return of the men on the completion of their sentences. This manner of working the men was ended by

the Civil War. I understand that similar arrangements were made by a number of the other states, but so far as I have been able to discover, very few men were used in this way. Just after the reconstruction period, Virginia established what is known as the county chain gang, or county road gang system. Under this plan a county could establish a prison road camp, using men from its jails in grading and improving its roads.

In addition to this plan, the state agreed to furnish to such counties as would make application for them, a force of prisoners from the state penitentiary, to be used in road improvement, the superintendent of the penitentiary to use his judgment in the selection of the proper men for road work, the county agreeing to feed, clothe, guard and otherwise provide for them and to return them to the penitentiary at the expiration of their sentences. The superintendent of the penitentiary had general supervision of these camps and made such rules and regulations from time to time as he saw fit or deemed necessary. I recall visiting two of these camps some twenty-odd years ago and my recollection is that they were run without any regard to ordinary sanitary rules or regulations. Should a prisoner escape, the county paid all the expense of the recapture, or, failing to recapture, the county was fined by the state. This plan was either not very popular, or else the counties did not realize the necessity for improved road work, since only a few counties availed themselves of this privilege. As a matter of fact, only four counties of the one hundred had camps of this kind in 1905.

This then, brings us to the law under which we are now working. The legislature of 1906, realizing that some definite action must be taken by it for the upbuilding and improvement of the public highways of the state, passed what is known as the Withers-Lassiter law and created the present state convict road force. Under this law the road authorities of a county desiring to improve their roads make application to the State Highway Commissioner for a camp of prisoners. The commissioner makes requisition on the superintendent of the penitentiary for the number of men he thinks it advisable to employ on the particular piece of construction. These camps vary in size from thirty-five to eighty-five men. A sergeant with from three to five guards is sent out with each camp. These sergeants and guards are selected from a list furnished the superintendent of the penitentiary by the highway commissioner, and must be discharged on his written request. The sergeant receives from $600 to $900 and board per annum, and the guards from $300 to $420 and board per annum. These salaries compare favorably with those paid in other states. The camp is composed of three buildings divided into a sergeant's and guards' house of two

rooms; a sleeping house for the men, composed of two rows of bunks with an 8-ft. passageway down the center, and a guard's stand at one end; a dining house, divided into a dining room for the men, a dining room for the sergeant and guards; a storeroom for supplies, and the kitchen. Camp sites are selected with a great deal of care, particularly with a view to a plentiful supply of pure water and proper drainage; also that the walk to and from work may be reduced to a minimum. This, in the most extreme cases, should not exceed two miles. The cooking and washing, in fact all work about the camp, is done by prisoners, from three to five men being assigned to this work. These are taken from the men who are not capable of doing the heavier classes of road work. The men are divided into gangs of from eight to fifteen, each gang being in charge of a guard or a foreman. When possible guards should be used as foremen. This system, that is working prisoners under guard, is generally followed in the Southern States. In the Northern and Western States the men for road work are selected from the entire convict body and only the better class of men are used. As a matter of fact, in Virginia the percentage of trusties to the entire prison population is greater than in any other state, ranging from thirty to forty per cent. The escapes amount to little less than .035 per cent. As a matter of fact, there were 132 escapes and 88 recaptures out of a total of 3,509 men handled. The road work proper is in charge of an engineer or superintendent, appointed by the Highway Commissioner, who receives from $900 to $1,500 per annum. We have found that in many of our camps we can combine the duties of sergeant and superintendent in one man, saving something in salary, and a great deal in conflict of authority, since we have found it very difficult to accurately define the line between the two.

The prisoners are trained in all classes of road work. Trusties are made into roller-men, firemen, blacksmiths, carpenters, drill runners, concrete men, etc., the trusties being selected by the sergeant from the better class of prisoners. The state convict road force is composed of all male convicts, who are considered safe by the superintendent of the penitentiary and all male jail men over sixteen years of age, and this force when placed on a county road or in a county quarry is clothed, fed, guarded and transported by the state and placed on the road each morning free of all cost or expense to the county. Prisoners working on the road force have for good behavior a reduction of four days per month from the time for which they were sentenced. The last legislature appropriated $200,000 and the jail fees for that purpose. The men cost a little less than 53 cents per ten-hour working day, which is divided about as follows:

Provisions	.213
Clothing	.048
Salaries	.193
Mileage	.007
All other expenses	.067
Total	.528

By combining the duties of the sergeant and superintendent of construction we hope to very much reduce the salary charge.

In my judgment the West and North have erred in attempting too elaborate meals, while the South has erred in making them too monotonous. It is certainly true that the criminals of the various sections are different, but it is equally true that it would be a mistake to give the prisoner a more elaborate or a more meager fare than he was accustomed to as a free man. The federal government had undertaken some experiments along this line and will no doubt issue a bulletin giving the results obtained.

The county road authorities agree on their part that the work shall be done according to the plans and specifications of the State Highway Commissioner, and under an engineer appointed by him, and further, that they will furnish all teams, tools, materials, etc., and all necessary free labor to carry on the work systematically and economically. This about equally divides the cost of the road work between the county and the state.

In the last two or three years so much has been written sentimentally of the convict as a "brother" and a "pal," or cynically as a "brute" and an "outcast," that it has made it rather difficult for those of us who are trying to carry on the work to a successful and practical issue.

The question divides itself into two heads—the convict as a prisoner and as a citizen, and naturally what is done to improve the condition of a convict as a prisoner will make for the improvement of the prisoner as a citizen. Therefore, it behooves us who have to come in touch with this problem to give it careful study and consideration. We must realize that the problem which confronts us is a world-old one, where the criminal using all his wits in persistent endeavor to tear down the laws which society has deemed necessary for the protection of its civilization, and with this to learn two things, to temper our punishment of, and our mercies to him, with justice, remembering always that he is a human being who, for the protection of all of us, it has been necessary to confine as a means of impressing on him the necessity for obeying the law, and that in executing this law it is our duty to use our utmost endeavor to return him to society better able to cope with the conditions which will confront him when he regains his freedom. With this before us and after nine years of experience, I believe, that the solution of the prison question—certainly in Virginia—is to use the

men in the construction and maintenance of our roads. In road work there is little or no competition with free labor. The work and the healthy out-of-door life tends to build up a man physically, and when you do that you improve him morally; you train him as an expert in handling many pieces of road machinery, and, therefore, place him in a position to earn an honest living after his confinement. The work on which he is engaged is one of pressing need to the public and creates in the worker a kind of pride in his own usefulness.

I regret that I am not familiar with the convict road laws of the various states, but from such as I have seen, and using those of Virginia as a basis, I believe that an organization along the following general lines will meet the condition which we have to confront, both from the standpoint of an economist and a penologist.

There is nothing new in the following plan, the adoption of which I have for years, first as assistant Commissioner and later as Commissioner, urged upon the Governor and the Legislature. I would divide the prison population into four classes, and as a matter of convenience we will take these classes in reverse order: Class 4, long term and dangerous men; class 3, short term convicts and jail men; class 2, trusties, both convicts and jail prisoners; class 1, paroled men.

Class 4 shall include all murderers, prisoners sentenced to the penitentiary for second or third offences, men with records known to have been bad prior to their sentence. These men to be dressed in stripes—for, although I own, I should prefer some other distinguishing mark with less tendency to humiliate and degrade them, I realize that prisoners of this class must wear some badge of their condition—and worked under guard in stockades in state stone quarries. These quarries to be located advantageously, that is, with a view to the section they are to serve, and on some railroad or railroads serving that section. This material to be supplied to the counties for road purposes at the actual cost of producing the same. To secure an economical distribution of this material it would be necessary to obtain very low transportation rates from the railroads. In the State of Virginia we have always found the railroads ready and willing to cooperate with and assist the department in its work, realizing that the highways of the state are the feeders of the railroads and that the development of the two goes hand in hand.

Class 3 shall be composed of first term convicts and prisoners from the city and county jails and such men from class 4 as by experience you have found that you can trust, even in a small degree. These men should have some distinctive dress and I would suggest blue or brown. The

men from this class to be distributed throughout the state to the various state road camps and to be worked under guard in the construction of the county or district roads, a small per diem to be paid them by the county, one-half of which shall be paid them from month to month and the remainder to be paid them on the completion of their sentence. This would insure their having a small amount of money when they are given their liberty.

Class 2 to be made up of trusties or, as they are called in some states, honor men, to be taken from class 3, as they develop into men to be trusted. These men to wear ordinary khaki suits and to be worked without guards, either in camps composed entirely of trusties, or to be distributed to the other state road camps to be used as drivers, cooks, yardmen, enginemen, roller-men, in small gangs to spread stone or shape road, in building concrete bridges, culverts and headwalls. These men to be paid by the counties in which they are working, but rather more than class 3, and to be graded in their pay according to the class of work which they are doing.

Class 1. These men to be taken from class 2 and to be paroled for good behavior and good work, on the recommendation of the State Highway Commissioner and the superintendent of the penitentiary. They will wear ordinary clothing and are to be paroled to the Maintenance Department of the State Highway Commission and assigned by it to the various counties of the state to be used as patrolmen or in gangs on the maintenance of the roads which have been constructed under the state's supervision. They are to be furnished with proper quarters and to be paid a monthly salary by the county in which they are working, the amount of this wage to be agreed on between the State Highway Department and the county officials. Paroled men under this system would be made a regular part of the state and county free labor road force, the only difference being that the men would be required to report monthly to some general head and to be governed by the parole laws of the state.

The prisoners are now being trained in the construction of roads and it, therefore, follows that they could use the knowledge thus obtained in the maintenance of these roads after their construction. The state would, in this way, reap a double benefit for the service of these men, giving them honorable employment on the completion of their prison terms and in addition getting the benefit of the training which they have received during their confinement. Along this line there are a number of instances where the men, on the completion of their sentences, have been employed by the contractors as free laborers, also by the farmers who live near the work on which they have been engaged, and

by the road force of the county, thus keeping them away from their former haunts.

The success or failure of your convict labor road work will depend on the man in charge. But given a man of firmness, one with strength of character enough to keep his department out of politics, I believe you will have solved two very important questions, the betterment of your criminal classes and the improvement of your roads.

(Chairman MacDonald then read the following paper by Mr. Maloney, who was absent, opening the discussion.)

Discussion by J. E. Maloney

Secretary-Engineer, Colorado State Highway Commission

In discussing Mr. Coleman's paper on convict labor on highways, I believe that the general proposition as to the benefit to the prisoners, and the resulting advantage of the state, may be considered as being decided affirmatively, particularly so at least in the State of Colorado, and that the practical workings of the methods adopted in Colorado may be of interest and assistance to other states which propose to use some of their prisoners on state or county highway work.

The working of convicts on the highways of Colorado was first started in 1899, the first work being done in the upper Arkansas Valley, in the neighborhood of Buena Vista. The work was done under a bill introduced in the legislature by Senator T. J. Ehrhart. In this year considerable work was also done in Fremont County by the convicts. Later, in 1905, a bill was introduced by Senator Lewis, and another in 1907 by Senator Barella, the latter bill providing for a convict-built road from the New Mexico state line at the south to the Wyoming state line on the north. The Lewis bill, adopted in 1905, is the one under which our convicts are now being successfully worked on the roads. This bill is as follows:

S. B. NO. 224 by Senator Lewis.

AN ACT

PROVIDING FOR THE WORKING OF THE CONVICTS IN THE COLORADO STATE PENITENTIARY UPON THE PUBLIC ROADS AND HIGHWAYS WITHIN ANY COUNTY AND UPON THE STREETS AND ALLEYS WITHIN THE CITIES AND INCORPORATED TOWNS LOCATED IN THE STATE OF COLORADO.

BE IT ENACTED BY THE GENERAL ASSEMBLY OF THE STATE OF COLORADO:

Section 1. Upon the written request of a majority of the board of county commissioners of any county in the State of Colorado, the Warden of the Colorado State Penitentiary, situated at Canon City, in Fremont County, shall detail such convicts as in his judgment shall deem proper, not exceeding the

number specified in said written request, to work upon such public roads and highways of such county or as shall be designated in said written request of said county commissioners; Provided, That such county shall pay all additional expense of guarding said convicts while working upon said public roads and highways within such county, and shall furnish all tools and materials necessary in the performance of said work; and, Provided, That when said work is done within the limits of any city or incorporated town within such county, or city or incorporated town where said work shall be done shall likewise pay all additional expenses of guarding such convicts while performing said work and shall furnish all necessary material used in said work.

Section 2. Said convicts when employed under the provisions of Section 1 of this act shall not be used for the purpose of building any bridge or structure of like character which requires the employment of skilled labor.

Section 3. The Board of Penitentiary Commissioners are hereby empowered to adopt a special rule applicable solely to convicts employed on the public work herein authorized and contemplated, whereby convicts so employed shall be granted additional good time allowance; conditioned upon their good behavior and cheerful compliance with all rules that may be made by said board or said Superintendent for the management and control of convicts so employed.

Section 4. All acts, or parts of acts, in conflict herewith are hereby repealed.

Section 5. In the opinion of the General Assembly, an emergency exists; therefore, this act shall take effect and be in force from and after its passage.

(Approved April 11, 1905.)

Work was started on the state road from Trinidad toward the New Mexico line, and completed to the New Mexico state line in 1907 by Warden Cleghorn, using convict labor. The famous Sky Line Drive at Canon City was also completed in this and the succeeding year under Warden Cleghorn's administration, and the commencement of the system of working convicts without gun guards, and solely upon honor, was started by Mr. Cleghorn. Our present warden, T. J. Tynan, took charge of the work in 1909, and has extended and developed the system until at this time it is one of the very successful adjuncts of the state system of road work.

The selection of the trusties and the placing of the men at their various tasks are functions which very properly belong to and are exercised by the warden of the penitentiary, who is directly responsible to the state for the prisoners, and who is in touch with the men, and thus is able to pick out the men suited for the different classes of work. It will be noticed that the Lewis bill provides for the expense of guards, but the guards were not used at all, after the first two years' experience.

The convict camps are made up of all nationalities and races—many Mexicans and negroes being amongst them.

The desire to take advantage of the opportunities offered

by the work upon the roads is shown by all the prisoners, and the great majority of them exhibit a very keen interest in the work. All classes of crimes have been represented by the convicts worked upon the roads. It has not been found desirable or necessary to divide the convicts into classes—segregated according to the character of their crime, and if there is any division to be made among the prisoners, it should be based upon the individual characteristics of the prisoner rather than upon the crime for which he has been convicted.

Warden T. J. Tynan, of the Colorado State Penitentiary, in a recent talk before the Colorado Road Builders' Association, outlined his ideas and methods as to the selection of the men for the road camps, as follows:

> The Colorado convict road system consists simply in taking a number of trustworthy men out on the highways, starting the camps, and building the roads under the superintendence of a good, hard-headed road overseer. We found that one of the hardest things to do was to obtain men properly qualified to handle these camps.
>
> In the penitentiary, when a man comes to us with a sentence of say from five to ten years, the Warden does not see him or talk to him for a period of about three months, after which time, on any Sunday, the prisoner can see the Warden and talk to him of his hopes, ambitions and desires, in regard to his employment while imprisoned, and the cutting down of his sentence. We give him a chance to get out to the camps and work. In this way a man with a five-year sentence will receive, while in the penitentiary, one month's time for good behavior for the first year; two months the second year, etc., and in addition to this, for outdoor work on honor and trust, we allow him ten days extra time each month, so that a man on road work is able to cut his minimum sentence in half. If he attempts to run away, and is recaptured, he has to serve his full maximum sentence of ten years, and gets no further chance to make up any time.
>
> In our road camps we have 75 men and work them with the same overhead expense as 35 men. Increasing the number of men cuts down the number of camps and thereby cuts down a great part of the maintenance.
>
> The percentage of men attempting to escape was 1¼ per cent. at first, but of late we have reduced this to 1 per cent., so the loss from escapes is very small.
>
> The penitentiary furnishes the clothing of the men from its maintenance fund; the counties furnish all the rest. If it is necessary to return a man to the prison, the penitentiary pays for the transportation.

The state does not pay the convicts any salary or per diem for their labor, but they receive credits, as stated by the warden, which enable the prisoners to cut their minimum sentence in half. Any attempt to escape or violate the established rules results in the loss of all credits, and instead of cutting his minimum sentence in half he has to serve his full maximum sentence.

There are no armed guards used in any of these camps, the

men being placed entirely upon their honor, and I believe this is one reason for the very satisfactory results obtained. If you use armed guards to restrain the prisoners from any attempt to escape, then you should not exact any promises from the men; but if you do accept a promise from them to the effect that they will not attempt to escape, then they should be trusted; otherwise the moral effect of their promise is absolutely lost. Under the present system the attempts to escape have not been over one per cent., and when ninety-nine per cent. of the men keep their word it stamps the system as successful.

Captain E. H. Baldwin, superintendent of one of our convict road camps, has stated:

> The use of this (convict) labor not only cheapens the construction in the state, but it takes the men out into God's sunshine, where the steady employment and wholesome life of the road camps is accomplishing wonders in arousing energy and ambition, and some of these men have never before realized that they were capable of doing an honest day's work.
>
> Prison labor has some disadvantages. The men from all walks of life are thrown together, and in most cases they have to be taught the use of the road builders' tools, but as the work progresses the majority of them learn to take an interest and pride in their work.

Convict labor is especially adapted to rough, side-hill work, where but few teams are required, and where a large number of men can be used to advantage after the grade line is established and the work opened up.

The typical organization of the convict road camps in Colorado is about as follows:

The camp is placed in charge of a superintendent, who is assisted by one, two or three foremen, as the size of the camp may require. These men are all the salaried officials connected with the camp. There may be anywhere from 25 to 75 prisoners detailed to a camp. The selection of the men who are placed in charge of the camp is in the hands of the penitentiary officials. The salary of the superintendent runs from $100 to $125 per month, and for the assistants, the salary runs from $60 to $75 per month. In addition to salary, board is furnished in camp. In all the camps in the state the equipment is paid for from the county and state road fund. This equipment consists of wall tents of extra heavy canvas, with flies, and in the winter the walls of the tents are boarded and papered, and heating stoves provided. The men sleep in separate bunks in the tents; about four to eight to a tent. Then, there are the superintendent's quarters, the assistants' quarters, the cook and dining tent, the commissary tent, and the necessary tents and shelter for the stock. The men are well provided with clothes from the penitentiary, but are not in stripes, being clothed about the same as an average workman would be clothed around

any contractor's camp. The sanitary conditions are looked after very carefully, especially the cleanliness of the camps and the men. Sanitary precautions and close inspection of the health of the men are points which are conducive to good work.

The stock necessary for the hauling of supplies to the camp, or for work upon the roads is also paid for by the county and State road fund. An outfit for a camp of 35 men would run about $2,500, not including the cost of the stock.

In organizing a convict road camp, it is important that the men selected as superintendents and foremen or overseers should be properly qualified for their place, as these are most important positions, and the success of the work depends entirely upon their successful management of the men and the work.

The prisoners' transportation is paid for by the county and State road fund, except where a man is returned to the penitentiary for any infraction of the rules, or attempt to escape, in which case the penitentiary stands the expense.

In the camps, one of the prisoners is generally detailed to act as night watchman.

The designation of the road to be built, the surveying and engineering, and character of the work is in the hands of the county commissioners, subject to the supervision and approval of the State Highway Commission.

In regard to the actual cost and maintenance for these camps, I submit the following statement, which includes four camps:

No. 1—Two camps for the season of 1913 and 1914.

No. 3—One camp from June, 1913, to October, 1914.

No. 4—One camp during 1913 and 1914—total, 24 months.

In the first two camps during 1913 from October, 1912, to July 1, 1913, or ten months, the total cost was $6,284.74 (equipment not included). The total number of days in that period of time was 308. The total number of days worked was 248. The average cost of food per man per day was 31½ cents; the average cost per man per day was 61½ cents; this includes all salaries, repairs, stock feed, etc.; and the average cost per man per day actually worked on the roads was 77 cents. The average number of men in camp for this time was 40, about 8 of these being used about the camp. The average number of head of stock, 8; average cost per mile of road built, $2,513.89, they having completed 2½ miles of mountain sidehill work, 16 ft. in width.

In the second camp for the season of 1914, or from August 1, 1913, to September 1, 1914, being 13 months, inclusive, the total number of days was 396. The total number of days worked was 296½. The average number of men, 33; the average number of head of stock, 6; the average cost per man

per day for food, 37.6 cents, and the average total cost per man per day was 89.15 cents; the average cost per mile, $3,163.60; a total length of 3.67 miles having been finished during the season at a total cost of $11,613.96. The average cost per man per day actually worked on road, $1.50. This includes a drilling outfit, which cost $2,000.

The work consisted of mountain sidehill and some very heavy rock for about 1¼ miles, the balance was earth and loose rock, moderately heavy timber clearing, and the roadway averaged 16 ft. in width.

In the third camp the work started June 10, 1913, and extended to October 1, 1914, inclusive, making a total of 15 months. During this time some 6½ miles has been completed, at a total cost of $29,164.38. This includes about $1,800 for a portable drilling plant and gives an average cost of $4,487 per mile. Of this work about 4 miles is in heavy rock work, and about 1½ miles in heavy earth and gravel, and 1 mile of light earth work.

In the next camp the convicts have been at work for the past four seasons, and their work is mostly in open prairie country, and has consisted of a great deal of work with blade graders and traction engine haul for the graders, and also horse haulage for the dirt, and the grading and scraping machines. The average number of men employed has been 25, the average number of horses employed has been 16, the total miles of road improved has been 94, the total number of bridges and culverts built by the convicts was 60, and the total miles surfaced, 61. The average cost of this work to the county for the past four seasons has been approximately $1,150 per mile, including bridges and culverts.

In estimating the comparative value of the convict labor as against the free labor, it would be essential to have the yardage moved, and to have the classification of material. As in the case where the counties do their work by day labor, the engineer does not always cross-section the work, simply placing the center and grade stakes for the use of the superintendent, and an occasional cross-section stake, giving the width and general outline.

This, however, is not sufficient to fully calculate the yardage of any of these pieces of work. A comparative idea may be had by the actual cost of labor per day per man actually at work on the road. This runs from 77 cents to $1.50 per day, and having this figure compare the relative efficiency of the labor as between the prisoner and the ordinary road-laborer. I believe this work of the prisoners will show an average saving of about 25 per cent for the conditions under which they have been worked in this state. In some cases a much larger saving than this is shown, and in other cases the saving is smaller.

In addition to carefully selecting the men in charge of the work, it occurs to me it would be wise to have the State Highway Commission authorized to take entire charge of the direction of the work, especially as to the locality to be improved, and also in regard to the character of the work, in order that the improvements may be along some connected system of roads, rather than at disconnected points all over the state, and also in order that the work may be uniform and along standard lines.

During the years 1913-14 there was built in this state about 140 miles of road by convict labor in six counties; about 40 miles of it through mountainous rocky country, and about 100 miles through the more level plains section. This work is worth to the state probably $210,000, and has been executed with a net saving of probably 50 per cent. to the counties and the state.

In conclusion, I can say that the experience of the state of Colorado with the employment of convicts on the roads under the honor system without guards of any kind, has been entirely satisfactory.

However, it would seem only fair and just to the prisoners that they should receive some remuneration for their labor, besides the reduction in their sentences, after they have proven themselves worthy of the trust reposed in them, and while we do not, at this time, pay any per diem, still I am convinced that after a man has served, say six months on the roads and performs satisfactory service, he should be given a certain per diem of say 25 cents. This sum could be held in reserve for him until the expiration of his sentence, or could be handed to those who might be dependent upon him. This would enable the prisoner to have a little money accumulated, so that at the end of his sentence he would be able to live honestly while seeking employment, and get a fresh start in life.

(The following paper by Mr. F. G. Twitchell, which was presented at the congress at a later date, is inserted here for the purpose of assembling the discussion on this subject.)

Discussion by F. G. Twitchell

Division Engineer, Office State Engineer, Arizona

As the predominating interest, from the average standpoint, in the use of convict labor on public works, lies in the efficiency of the labor, rather than in what is generally termed the "uplift" of the prisoner, these remarks will deal principally with the cost of doing work under the "honor" system, this being the term that custom has applied to the plan whereby prisoners are placed in camps without guards,

reliance being put upon their word that they will not run away, and that they will conduct themselves properly.

The figures presented are taken from the records of the camp known as Prison Road Camp No. 1. This camp was organized in December, 1913, on a small basis, with the intention of using it for general repair work and minor improvements. When first put in the field it was made up of twenty-nine men and eight teams, under the direction of one foreman. Since that time it has expanded until it now has a force of fifty-five men and twenty-four teams, under the direction of three foremen, and is capable of handling, and has handled, every class of road work.

Acting upon the principle that if a prisoner is worthy of being trusted he is worthy of being trusted to the fullest extent, the ordinary prison rules have not been enforced in this camp. The endeavor has been to avoid as far as possible anything that would keep the man constantly conscious that he was a prisoner. Responsibility for his actions has been placed upon himself. I might say that he has been shown his feet, and told to stand upon them.

Carrying out this idea, the men are dressed in civilian clothes, and with two exceptions are not restricted any more than in a free labor camp. The first of these two exceptions is that there is a set hour for going to bed, and the second is that the men are not allowed to leave camp without permission, and then only to the extent of a one mile free range. Under no circumstances are they allowed to go to town. One guard, who acts as night watchman for the camp, is employed, whose principal duty, outside of this, is to look after the clothing and equipment of the men.

The food furnished is on a par with that furnished in the best free labor camps, and better than that furnished in many. We have been criticized a great deal on this point, though I believe this criticism has been without proper reflection. The average idea is that any kind of food is good enough for a prisoner, but that idea is based upon altogether wrong premises. It is not a prisoner that is being fed, but a workman, and this is a fact that must never be lost sight of. It is probably not necessary for me to remind you that a man poorly fed is a man who is discontented both in mind and body, and whose work will reflect his state of being.

For sleeping quarters tents are furnished, which are heated in the winter time. Each man is furnished with a cot, mattress, sheets and blankets. We have been accused of pampering the men by supplying sheets, but you can readily see that this is a necessary procedure in the interests of cleanliness. For this same reason one man is detailed as a laundryman, who takes care of all the clothing. An effort to have each man wash his own clothes did not prove successful.

Taking up the matter of cost, which is of course of the first importance, there is one point to which I wish to call your particular attention. The aggregate cost of road work is made up of many items, the most important of which are cost of labor, cost of teams, cost of material and cost of superintendence. The cost of teams, material, and superintendence is as great in a prison labor camp as it is in a free labor camp, leaving the cost of labor as the only item on which we can effect a saving. At first glance this might be supposed to be very large, but when compared with the total cost of a piece of work it does not show up to as great an extent as anticipated. To demonstrate, I will say that this camp under discussion, during the period from December 15, 1913, to January 25, 1915, spent nearly $30,000 on the Globe-Roosevelt highway, and of this amount, $10,477, or about one-third, was the cost of maintaining the prisoners. Of the balance, the maintenance of the teams took nearly $6,000, paid labor took $3,000, the material bill for culverts, cement, powder and similar items was over $6,000, and maintenance and depreciation on the equipment was about $3,000. You can see from this that it would not be fair to expect convict labor to show any startling saving over free labor in the total cost of the work.

It has been with regret that I have heard some advocates of convict labor say that they believed in it for the reason that the State had to maintain the prisoners anyway, and some benefit should be derived from the expenditure of money that had to be made, whether the men were out on the road or inside the prison walls. I say with regret, because I have had to undeceive them, and let them know that the cost of keeping a prisoner in prison has no relation to the cost of keeping a prisoner in a road camp. Laying aside the fact that a prison is a large plant in a fixed location, with easy access to supplies, and that large operations allow low unit costs; and the road camp is a small plant, constantly on the move, with heavy transportation expenses, both for men and material, the outstanding reason that it costs a great deal more to keep a man on the road is that this man on the road is doing rough, hard, manual labor. He needs a lot to eat, and he wears out a lot of clothing.

On the Globe-Roosevelt highway last year it cost us 78 7/10 cents per day to keep a man, this covering food, clothing, medicine and tobacco. This cost per day was for every prisoner in camp, including the camp force, of cooks, flunkies, etc., who are generally known as "non-producers," and for every day in the year, including Sundays and bad weather days when no work was going on. The cost per man working day, by which I mean the cost of putting the prisoner on the job, for every day he actually worked, was $1.29. I wish to remind you that this working day cost had to in-

clude the cost of the camp force on working days, and the cost of maintaining the whole camp on Sundays, on days when the weather would not permit of work, and on days when the camp was moving. I might mention here that during the period of thirteen months referred to the total number of days lost from these causes was ninety-seven; over 25 per cent

With this information, and taking into consideration the facts that the work was largely repair work, and reconstruction; that it was scattered over some thirty miles of road; that the average water haul was three miles; and the average supply haul was twenty-one miles, we will take up the most important matter of all, that of unit costs.

Clearing and Grubbing. Largely mesquite and chapparal; the average cost for some 57 acres was $9.18 per acre.

Solid Rock Excavation. Total quantity moved, 4,392 cubic yards. Where this work was so located that full benefit could be derived from the necessary drilling and shooting, the cost ran from 65 cents to 85 cents per yard. When it consisted largely of shooting off projecting points, and widening the road at narrow places, the cost was from $1.25 to $2.50 per yard. The average cost for the total quantity moved was $1.27 4/10 per yard.

Loose Rock and Boulders. Total quantity, 9,300 yards, ranging in cost from 26 cents to 81 cents, this latter being material that had to be shot, although it could not properly be classified as solid rock. Average cost 66 3/10 cents per yard.

Earth Borrow and Excavation. Total quantity 20,428 yards, ranging in cost from 14 cents to 45 cents per yard. Most of this work was on steep hillsides. Average cost 25 2/10 cents per yard.

Foundation Excavation. Total quantity 688 cubic yards. Average cost 56 1/10 cents.

Dry Walls. Total quantity 126 cubic yards. Cost $1.18½ per cubic yard.

Rubble Masonry. Total quantity 612 cubic yards. Average cost $3.82 per cubic yard.

Concrete. Total quantity 116 cubic yards. Average cost $13.16 per cubic yard. This high cost is principally due to the small quantity placed, which did not permit the men to obtain experience and skill in form building and concrete mixing.

Ditching. Total quantity 5,209 yards. Average cost 35 3/10 cents per yard.

I wish to also submit the costs of the work done so far by this camp on the Tucson-Florence highway in Pima county. This work is new construction, and in consequence of not being scattered, is being performed cheaper. The

water haul has been three miles, and the supply haul nine miles, and we have been able to reduce the cost of a prisoner working day to $1.14 4/10.

The unit costs on this work have been as follows:

Clearing and Grubbing	per acre	$15.82
Earth Excavation and Borrow	per cu. yd.	.182
Solid Rock Excavation	"	.844
Ditching	"	.175
Concrete	"	9.88

When comparing these unit costs with contract prices for similar work, it should be remembered that a contractor has three sources of profit that are denied us. These are the boarding house, commissary and medical service.

In concluding I wish to make a few remarks about the effect of road work on the prisoners, not to make any plea for sympathy for them, for their punishment is not unjust, but to present a strictly utilitarian fact. The prisoner who has been doing hard manual labor, and it is hard manual labor, for a period of months, living an outdoor life, with good food, and enforced good habits, when released is a strong, healthy man, and is much more likely to try to keep straight and earn a living than a man who has been made soft and weak, and had the heart taken out of him by long confinement behind the prison walls.

CHAIRMAN MACDONALD: Now, are there any questions you would like to ask?

MR. WILLIAMS: There are one or two thoughts in connection with Mr. Coleman's paper that I would like to emphasize briefly, and one or two thoughts in connection with Mr. Maloney's discussion: the first, beginning at the discussion and going backwards over the paper. I came through Colorado some days ago and had a chance to observe the location of the Colorado camps and the placing of their men. The conditions that apply in Colorado as to the location of the camps is absolutely different from the conditions that apply in the East. Where the Colorado camp was located as I observed it would be impossible for a man to escape if he saw cause to. In West Virginia the country all being timbered it is possible for a man if he is six feet from the road to be out of sight of the guards and never be seen any more. We have had that occur some times with some of our men.

Here is one thing that we have learned; that we cannot work our ten and thirty-day jail prisoners with long-term prisoners successfully. The reason is the men become acquainted with the men that are there for a greater length of time and when they get out they act often as an associate

or a pal to assist them in finding ways to get away. For that reason we have in our state prison camps selected men that have longer terms; men who have been sentenced five, ten, fifteen and even life-time prisoners, and those men are placed out after they have served three or four years in prison. They make the best honor men because they by that time have received the drill and the discipline of the prison life. On the other hand, they have gone far enough in the earnings of their good time that they do not care to sacrifice. For that reason we have reduced our attempts to escape to a very low per cent.

Another problem that has given us some trouble is the preparation of food. The sanitary preparation of the food and the proper cooking of it and serving of it in camp has much to do with the comfort and satisfaction of the men and their contentment. If you feed your men right in the camp it has a great deal to do with extending the latitude of the honor you can confer on them. I agree very much with Mr. Coleman that the prisoners should be paid, but, gentlemen, I doubt very much, judging from my own experience in West Virginia, as to the revulsion of feeling that you find in some sections from the labor organizations, whether or not it would even be possible and practicable to make it so that the counties would pay for the prison labor to any extent. I think your pay must come in the form of concessions in the way of giving off time; and providing that certain payments might be made and can be made and should be made for the benefit of the family of the prisoner while he is serving the state; and that to come from the state instead of from the county. (Applause.)

MR. EDDY: Mr. Chairman, I represent California and I am from the exposition, the bureau of congresses, but I do not wish to involve either California or the exposition or the bureau of congresses in what I have to say. It is simply a private opinion. I wish to be recorded as opposed to all convict labor. Convict labor is slave labor. I would rule out all reference to the ancient roads of Carthage and Rome for the simple reason that they are paved with human blood and flesh by the men who made the roads and couldn't use them. In this day we have free men that can build the roads. I have said before in this congress that the building of good roads is a good investment and it should be paid for. I don't believe in the use of convict labor, although our state of California has adopted the principle.

Now, there are three public utilities in the United States, the post-office, the public schools, the roadways or highways. They are all public utilities. There is just as much reason for hiring a competent teacher from the prison and putting him in a school in the United States as there is in building roads with prison labor. There is just as much reason in

making the prisoners or convicts mail carriers as there is in putting them on the roads. I am opposed to the whole principle and I don't believe that we can get the aid that we expect in the different states of the United States government as long as this principle is employed.

MR. GASH: Mr. Chairman, I am somewhat in favor of the convict labor system, and we have had it in force in Illinois for the last two years upon the merit or trusty basis. I realize that much of what the last speaker said is true, that it is slave labor. It is enforced slave labor because of the individuals having done something against the rules and laws of society. Now, the thing that makes me in favor of this convict labor is that it is better for each individual on earth to be employed in some useful avocation, no matter what his condition in life. (Applause.) We employ them in manufacturing products within the prison walls. The thing that makes me in favor of going a little farther than that, and employing them under the sunlight of heaven is, that it will rehabilitate them in my opinion in society. Use those that can be trusted. All of them will not stay that are selected, but have your men carefully selected.

The trouble has been with convicts of the past that if an individual man or woman happened to step aside from the paths of rectitude and committed a crime and was convicted, however slight the crime might have been, if he went behind the jail or the penitentiary walls, that when he came out his fellows would not trust him. He could not get any kind of useful occupation to make a living at because of that distrust. I am in favor of selecting these men carefully, and we have done it in Illinois in the last two years, and very few of them have attempted to go away. They are put out not with salary to the men except they work overtime, and then they get so much an hour for overtime. That goes to them individually. The communities that want them call for them,—the road officials of the township. They are not worked under the state aid system. The state highway commission, of which I am a part, cannot call for these laborers. We let all our work by contract, but the convicts are selected and sent out because it is believed by the warden that they can be trusted. By the way, the law provides that their sentence shall cease within five years,—those that are to be trusted,—but I have had the warden tell me that men who were in there for perhaps an inadvertent crime for life, that he believed that he could select some of those men and send them to China and that they would be back on the day that they were to return. Now, these men are selected and put out upon these roads, and the camps have been established in various places where the people have called for them, and, as I have said, very few of them have left. Men

have come down there from the factories to those camps from Chicago and said, "If these men make good, certify them to us at the end of their sentence and we will give them some useful employment."

By the way, the governor gives one day off for each three days of faithful service. Thereby the man that goes out and makes good rehabilitates himself and he is certified to that employment or work in the open day, and he goes out into society with a position where he can earn an honest living and he is not pointed to and scorned at because he once happened to step aside from the paths of rectitude. That alone rehabilitates the convict and works for the betterment of society, as I believe. This is what makes me in favor of the system. They are not in conflict with the free laborer because we put them out at fifty cents a day. That is paid for their keep. It always goes to the keeping up of the camp. The state don't make anything by it, but the state profits because it rehabilitates every man in his own manhood that will go out there and make good. (Applause.)

MR. KENYON: I have just one thought in reply to the suggestion that was made by the gentleman who is opposed. He said that that was slave labor and compared it with the ancient times when they went out with their armies and captured men who had done nothing wrong and made slaves of them, put them on the road, and so on. But is this slave labor? These prisoners have offended the community. They have done a wrong and a damage to the community. Is it not right that in return they should do something for the good of the community to pay for the damage that they have done to the community? I know that the idea that the gentleman has expressed has done a good deal in the way of stopping the use of prisoners. I know in my own state the state board of charities are opposed to the use of convicts on the road. I never knew exactly why. They put them on the farm, the penal farm; they advocate that, and have them work there and sell the commodities that they raise. What is the difference? It is a question for the benefit of the community in either event. There they come in contact with free labor and the labor unions as a rule are not opposed to it. I have been wondering what the opinion of the penologists and those who have studied this question carefully and thoroughly is on the subject.

MR. TERRACE: This convict question is an important question. It has been before the minds of the different states of this Union for a long time. The great trouble has been with the American people. They have not had the courage to tackle it as it ought to have been tackled. They are willing to push the convict labor onto the farmers because they

think that they are unorganized. If the farmer would organize himself and come out on a strike for one month what would the people of this great country do? They have borne the brunt of everything that has come along. I will take my stand. I will show you the inconsistency of this question.

In our penitentiary they make grain sacks. Those grain sacks are sold to the eastern Washington farmers that raise wheat. The farmers in that section of the country think it is a fine thing and they are opposed to allowing the convicts to go and work on the public highways. Has the eastern farmer any more right to get the benefit of those convicts making sacks than I and other dairymen have for them to make our milk or the fruit growers for them to make fruit boxes for the fruits? We pay our share of the taxes to maintain those convicts in the penitentiary, and I mean to say that the whole public should be benefited by the employment of those convicts if they can be put to any use.

Now, then, what use can we put them to? We can put them making our public highways in our mountainous countries, to do their fair share of the work on these public roads. As you know, every man, woman and child uses these roads every day in their lives, so that we are all interested in them.

I was sent by my grange down on the Columbia river into a convict camp to find out the treatment that these men were getting at the hands of our state highway commissioner. I went in when the men were eating and I ordered the guards outside of the door and I was left alone in there with one hundred prisoners. "Now," I said, "men, do not be afraid to speak up voluntarily, as there is nobody here to intimidate you. I have been sent down here by the grange to find out how they are treating you." Every man got up in his turn around the table, and he said: "We are well fed. We have the sunshine on us every day. We can see the boats go up and down the Columbia river, and each day counts two, and it is better for us. We have learned to work, which we never knew before, some of us, before we came into this institution. We are now ready to go out in the world and take our place side by side with free men and make the battle of life, which it is every man's duty to do." "Now," I said, "I am glad to hear that. I will go back with that message to the farmers of my country and tell them just what you have said." I say it is better for them, better for the community and better for everybody. (Applause.)

CHAIRMAN MACDONALD: I have just been advised that the Committee on Resolutions, the chairman of which is Mr. Tillson, is now ready to report, and we will be glad

to hear them, and then we will take up the discussion again.

MR. TILLSON: Mr. Chairman, before presenting the report I would like to present a telegram from the mayor of Boston and a letter from the president of the convention bureau of the Boston Chamber of Commerce inviting this convention to meet next year at Boston. They were sent to me as president of the American Road Builders' Association and I just put them in for the record and future action.

CHAIRMAN MACDONALD: They will be placed on file.

Boston, Mass., September 7, 1915.

Mr. George W. Tillson, Pres.,
American Road Builders' Ass'n,
Oakland, Cal.

Dear Sir:

The Boston Chamber of Commerce, through its Convention Bureau, extends to the American Road Builders' Association a cordial and hearty invitation to select Boston for its 1916 meeting place.

This invitation is supported by Mayor Curley, of this city, and we ask you to present it to your members at the convention to be held in Oakland next week. We hope very much that it will be acted upon favorably and we can assure you that the citizens of this city will be extremely pleased if your convention selects Boston for its 1916 meeting place.

Just a word as to the attractions and advantages of Boston as a convention city. Taking into consideration commerce, industry, financial activity, history, art, literature, education, music, recreation and vacation advantages, we have here one of the most significant cities in the world, and the most genuinely interesting in the United States. It has, as everyone knows, scores of places about which the history of the country centers, scenes famous for their literary traditions, institutions that rank first in the educational, artistic and musical life of today. The fine beaches and seaside resorts nearby, the magnificent automobile trips through the finest park system in the country, the famous North Shore and the White Mountains within striking distance add still more to the abundance of attractions which the stranger meets on his arrival here.

Boston offers you every facility and convenience as a meeting place. By coming here you will be assured of a maximum attendance and here you will receive exceptional publicity. Our daily newspapers and the trade journals will give your aims and purposes, as well as the results of your sessions, the space and attention that they deserve, and you

may rely upon our cooperation in every possible way to secure the success of your meeting and the comfort and enjoyment of your delegates.

Wishing you a most successful convention this year and anticipating the pleasure of having you here in 1916, I remain,

Yours very truly,

(Signed) JAMES C. McCORMICK,
President.

Boston, Mass., September 13, 1915.

Geo. W. Tillson, president American Road Builders' Association, Oakland. Boston sends greetings to American Road Builders' Association in convention at Oakland this week, and cordially invites members to select Boston for 1916 meeting place.

(Signed) JAMES M. CURLEY, Mayor.

MR. TILLSON: The committee on resolutions met in session this morning and unanimously adopted the following resolutions and instructed me to report them to this meeting with the recommendation that they be adopted:

Resolutions

"No. 1. Resolved, that the Pan-American Road Congress expresses its regrets that circumstances have prevented Governor Charles W. Gates, chairman of the executive committee, from presiding at this congress; and it hereby extends to him its heart-felt sympathy in his time of affliction; and that a copy of this resolution be transmitted to Governor Gates."

I move its adoption.

CHAIRMAN MAC DONALD: You have heard the report of the committee relative to the resolution of condolence for Governor Charles W. Gates. What is your pleasure?

MR. WILLIAMS: I second the motion to adopt.

Upon the motion being put by the chairman it was declared carried.

MR. TILLSON: "No. 2. Resolved, that the Pan-American Road Congress recommend to the congress of the United States the advisability of investigating the necessity of building a hard surfaced Highway along the Pacific Ocean side from Mexico to British Columbia to be used as a military and commercial highway."

I also move that that be adopted.

CAPTAIN COGGESHALL: I second the motion.

CHAIRMAN MAC DONALD: Gentlemen, you have heard the motion by the chairman of the committee on resolutions, which motion has been seconded. Are there any remarks?

MR. GASH: Mr. Chairman, I am opposed to the resolution, not because I am opposed to the Pacific coast, for I am not. I have traveled from Vancouver to Oakland, and yesterday over to San Francisco. This is my first trip to the Pacific coast. I am going to travel to the south border of the United States before I go back to the East. I have been many times as far west as Utah, and I have met gentlemen of the highest order from the Pacific coast, oh, so many that it would take me weeks to tell you the good things that I have read and heard of the Pacific coast, and that I have in my heart and mind, and I believe them all; but Mr. Chairman, the United States of America has built the greatest highway that was ever constructed by man, the Panama canal, for the benefit of all the people of the United States; to make the fleets of the Pacific coast, each vessel thereof, whether submarine, battleship or cruiser accessible at all times of danger to the Pacific coast as well as to the Eastern coast. It has expended in this beautiful country of ours millions of dollars upon our coast defenses and upon the rivers and harbors, the most of which are along the edges of our common country.

This resolution goes to the internal improvements of the highways which reach every home in the land. We do not envy all that has gone to the border, or to the western sea coast, or to this great highway that is for the benefit of us all, that we are here celebrating at this Panama-Pacific International Exposition. We say that we want such improvements, and we want those appropriations for the benefit of splendid harbors, such as this at the Golden Gate, at Boston, at New York, at Charleston, at New Orleans, and various places around the border. But when you come to ask Uncle Samuel to get into the question of road building that comes home to every citizen of the United States, I say here today that I am opposed. Because I believe in the principles enunciated in the Declaration of Independence. It says, "We hold these truths to be self-evident, that all men are created equal; that they are endowed by our Creator with certain inalienable rights, that among these are life, liberty and the pursuit of happiness, and to secure these rights governments are instituted among men deriving their just powers from the consent of the governed."

I am in favor of the government of the United States getting into this question of internal improvements, assisting in the road construction of the United States, because he uses them to carry the mail more than any other one of us individuals, but when he comes into that internal improvement I don't want him to select any highway in any state or combination of states; but I want him to leave it to the state highway commissioners of the various states

to select the roads that will be improved. (Applause.) If he makes an appropriation upon this question, and I am in favor of him doing it when he gets away from this heavy expense of the building of the canal, which will be in a short time, and it will begin to be a paying institution, an investment, to carry the products of the world; when he gets away from this thirty-five million dollar improvement for opening up Alaska with that railroad; when he appropriates a million and a half for improvement of the highways in Haiti, and a like amount in the islands here to the west; and three million dollars for the improvement of highways in the Philippines; I believe that he will come home and conclude to assist us communities in the betterment of the roads, the highways of the United States and I am in favor of that. When he gets away from these heavy expenses I am in favor of him appropriating one hundred million dollars a year to assist the various states in the construction of the highways. (Applause.) But I am in favor of apportioning that, Mr. Chairman, according to the population of the people of these United States to the various highway commissioners of the various states that are likely to expend it as will the state of Illinois. The Illinois law, apportions to each county in the state its pro rata, and will make a pro rata to each county that which will come from the aid of the government of the United States. Then, all the people in every community may partake in this splendid improvement.

In a few years, believe me, it will cost one hundred and eighty million dollars to make this system of roads that has been laid out by the Illinois highway commission; and I believe that the best work and the best service that we have done to that state in the last two years, from the moment we were appointed, was to figure out just what the sixteen thousand miles would cost building the various widths of the particular material that would serve the various communities best. Now, Mr. Chairman, we have heard much of the Pacific coast. I don't object that these states are selecting one road for their particular portion that comes from Uncle Samuel, to build this highway from the Canadian line to the Mexican line, but when Uncle Samuel gets into that thing, I am in favor of him giving the pro rata to the great heart of the United States. We have heard much of the beauties of the Pacific coast since we have been in this congress, every word of which I approve of heartily; every word of which I believe each individual in this congress, coming from whatever state he may, approves of. It was my privilege to drive up and down the Eastern seaboard in May of this year and see the beauties over there. We love them all. We love every foot of ground in the

United States of America, but we have got some beauties in the Mississippi Valley, the great heart that feeds the people of this country, that sends its products abroad to help feed the rest of the human family of the world. And we have got some beauties there we want to call your attention to just for a moment.

I don't want to take up too much time, but let me draw a picture of the Mississippi valley that is in harmony with the beautiful picture of the eastern seaboard and the beautiful picture of the Golden Gate of California, Washington, Oregon, Utah and all of the inter-mountain states. When I think of the improvement of that vast country during the last century the story seems incredible. A hundred years ago it was a vast, fertile, wild country, with lakes sparkling beneath the sunlight of heaven, and rivers gently flowing toward their meeting with the great Mississippi. And beneath the placid surface of the lakes and streams the fish flirted with their fickle mates without disturbance from the angler; the song birds piped their merry notes in the forest; and the redmen chased the wolf and bear and deer over wild prairies, through woods and over hill and dale. But there was not heard the sound of a farm-yard fowl, the lowing of domestic herds, the music of industry or the sound of the builder's mallet. How different is all of that today. The whole vast region is occupied by civilized man and there is under cultivation every cereal, vegetation and flower known to the north temperate clime. Ah, the cocks you hear at the break of day, from home to home throughout the length and breadth of the whole vast region, calling on all to waken for the day's pursuits; while the lowing of the domestic herds at eventide, betokens the approach of parting day. The whole region is dotted with villages, cities and towns that are linked together by rails of steel over which the iron horse feels his way, making the whole vast region one mighty neighborhood. We can go to sleep in a palace at Chicago at night and awaken at Pittsburgh, St. Louis, Kansas City or St. Paul the next morning. We can talk from one side to the other, and each hill and dale is bedecked with a schoolhouse or a church spire. These schools and churches testify to a great civilization, the intelligence of which is not to be excelled by any land beneath the sun. It is for that broad area which furnishes the grain for the world, the cotton to clothe the people, that I plead here today as a citizen of the United States, that this resolution be made broader. That if Uncle Sam gets into the construction of the highways of the people that he gives to each locality, the states of this Union, an equal chance and apportion the money according to this population. I plead for the defeat of this resolution or I want you to make

it broad enough to cover every state and you may apportion your part to one road, but leave it to us to apportion the part that we get to whatever highways we may see fit. (Applause.)

MR. HILL: May we have the resolution read again, please?

CHAIRMAN MAC DONALD: I don't think Mr. Gash quite understood the resolution. I would like to have the chairman of the committee read it.

MR. GASH: Let me hear it read again.

(Mr. Tillson read the resolution.)

MR. TILLSON: I cannot see anything in that resolution that interferes with anyone's constitutional right to enjoy life, liberty or the pursuit of happiness. Remember, there is not a thing said here about construction. There is not a thing said about who should pay for the cost of this work if it should be built.

MR. GASH: The trouble with it is we all admit the advisability of every road, if I may be pardoned a moment.

CHAIRMAN MAC DONALD: Mr. Gash, excuse me. I recognized Mr. Hill.

MR. HILL: I yield. I would like to hear him finish.

CHAIRMAN MAC DONALD: Mr. Hill yields the floor.

MR. GASH: We admit the advisability of every road, but we want to make all of our highways on the Pacific coast lead down to the principal places, so that they can be used by Uncle Samuel as military roads, and by the people as pleasure or business roads, and why select one highway? It is unconstitutional to expend on one particular highway. Did it ever occur to you——

MR. TILLSON: That question is not up, Mr. Gash, in the resolution.

MR. GASH: No, but I am naturally opposed to the resolution because it asks congress to appoint a committee to expend to go out and search for one highway and select it to be made a military highway of the United States. I am opposed to military highways within the confines of the United States in that sense of the word. I want all the people to use every highway and I am opposed to the resolution for the reason that it has in it the question of establishing a military highway. This is not a military government, although we will defend ourselves against all comers and goers if they attack the United States of America. Every man will lay down his life, and he teaches his children so, but we don't want any military roads in the United States of America. We want the people's highways, the greatest of all public utilities. (Applause.)

I think I understood the resolution, and I am opposed to it more for the use of the word "military" highway than

any other thing that you have got in it. Why should Uncle Sam select some military highway if he isn't going to build it? Why should he expend money to get a committee to come out here to the Pacific coast that we all love, to select a military highway if he is not going to build a military highway? This congress should go on record asking that Uncle Sam ultimately get into this road construction, because he uses all of them as mail highways to carry the mail of the people of the United States. No. I am opposed to the resolution. I understood it in the beginning; but I thought if we passed that this year and Uncle Sam goes out and selects a military highway, won't this congress go on record asking him to build that highway at a later day? Everything I do I look forward to the future, what effect it will have upon my fellows in the future. It is not today that I am building for my children and my neighbor's children and myself, but it is for next week, next year, and the year following and for all years to come. Now, Mr. Chairman, that military proposition, let us eliminate that from this congress.

MR. HILL: Mr. Chairman, I am very sorry I am not an orator. I am only a plain business man, now a farmer. I have listened with great interest to the description of the Mississippi valley. I lived for forty years in Minnesota and perhaps know something about the valley. I have walked from the Great Lakes to the coast.

I think I may say, if you will pardon me, I am almost an American. I have a house in Washington, D. C. I have a house in Massachusetts, a house in Minnesota, a house in Seattle, a house now being erected in California, but thank God I can live down on the farm. I am not localized in speaking about conditions throughout the United States. I have the very great honor to be the president of the Pacific Highway Association. If all goes well by 1916 you will be able to drive from British Columbia to Mexico over this road.

How much has Illinois bonded itself for good roads?

MR. GASH: Not for a dollar. Two counties have bonded.

MR. HILL: California has bonded itself for eighteen million dollars already and it contemplates another bond issue.

You go out to the Presidio and you will find an impregnable fortress. Men competent tell you that twenty-five miles below that you could land a force and take this country. That is your condition today in the United States. The United States is in a very precarious condition.

I am tired of this peace talk. Now what we propose is this: We have asked to have this matter investigated and see what is in it, to see if it is possible to safeguard this

government, because sometimes preparation in a time of peace prevents war. The constitution provides for post-office and post roads. These states have gone as far as they should go in building their own roads under the highway commissioners and we are simply asking the government to see if it is not a wise thing sometime to investigate this back door. You men down in Illinois fold your arms and talk about song birds, but we are out on the front on the firing-line, because the population of the world, if it ever starts towards the United States, will come over the Pacific Ocean to this coast. Why, gentlemen, this land right up and down this coast is so fertile that every ten acres, when properly cultivated will support the best men with their families. You need no army and navy. You will have that wall of flesh up and down that coast. Is there any better way to do it than that? Is there? Now, gentlemen, we ask nothing at all. We object, though, to having anything said of this character that one part of the United States has it all. I don't think it has. I like the Pacific coast. I believe in it.

I also believe in my country. What did you do about this matter on July fourth, the "Treaty of Peace?" What did Illinois do about that? We have had a hundred years of peace between Great Britain and the United States. Did you celebrate that peace in Illinois? No, you did not. We celebrated that peace in Washington. The whole of Washington came out and celebrated that peace on July 4. Now, what happened?

I have taken up too much time, perhaps; I have spoken too seriously. All I urge is this, that our government shall think of what it is doing before it makes these large expenditures. They talk of getting down to hardtack. I had three men dining with me, and I showed them my model maps. The men were George Dewey, James J. Hill and John Stevens, all competent to talk about transportation, too.

MR. GASH: Oh, yes.

MR. HILL: I got a piece of paper and a pencil and showed the admiral that if he had the battleship Oregon at the Panama Canal and started to sail to Seattle, Washington, to repel an attack then made by any foreign power, a vessel could sail from Japan and be there a day ahead of him on this side of the coast. That is your condition. Now, what I mean is, our country here is a whole country. It is not limited to Illinois, Indiana and Ohio; they are good states, but not the whole country. I think this is a wise provision. I have traveled a great deal and speak from experience, and say to you that no country today in all the world, unless it be China, is so thoroughly unprepared. I

want congress to investigate and see if we can't learn where we are, and where we stand. (Applause.)

JUDGE ALBERT: The gentleman painted a beautiful picture, and in the painting of that picture, all of which I saw and part of which I was, I recognize the vast difference between the terms that the government settled the West upon, and that which was done in Oregon. These things were possible, and that country was cultivated and is now a great country, because the government of the United States disposed of its land. Everybody could get land at $1.25 an acre, and it was taken at once, and the state received the tax upon it, and people improved it, and the population grew from that. What has the government done on the Pacific coast in Oregon? Sixty per cent. of the land is still in the government, and the government won't sell you the land. It goes into the timber business. It won't put a price upon the land, and comes in and competes with our people who have land. That United States road can be built to Oregon and Washington, without going off government land. What do you think of that? Sixty per cent. of the land is withheld from the people. Some of that is valuable agricultural land, and much of it the best timber land in the world. If we had the tax from that land we could afford to build a road ourselves, so that in dealing with the past the government is in a different position entirely. I ask you why can you question the justice of the United States which has this land to sell—it won't put a price on it—what injustice is there in the government building a road through this land and increasing the value of it from ten to twenty fold? The government can afford to do it, and it will enhance the value of the land sufficiently to pay for three roads through Oregon. That is the situation in regard to the West. It is just and it is right.

MR. ROGERS: It seems to me that it is unfair to put a question of this kind, which will go out all over this country in the newspapers, and said to be a resolution adopted by a joint convention of the American Highway Association, the American Road Builders' Association, and two associations on the Pacific coast. Now there are but a few people here to speak for the American Road Builders' Association and the the American Highway Association. Therefore I object to placing a question before this audience of this character and taking a vote on something that is purely local, and herald it all over this country as a resolution passed by the Pan-American Road Congress. (Applause.)

MR. JOHNSON (Manitoba): This question raised by this resolution is a very important one, no doubt. I come here as a delegate, and am invited to this convention from one of the provinces of the Dominion of Canada, and while I do not think it conceivable that a military road, if constructed as is

suggested here, should ever be detrimental to the part of the country that I come from, because I do not think it conceivable, neither does any Canadian nor any American think it conceivable that the United States and the Dominion of Canada can ever be at war (applause), yet I cannot but feel that this congress being a Pan-American road congress, should not be asked to make recommendations to the United States as taking steps of a military nature. I think that that phase of it, when we look at the constitution of the congress, that it is a Pan-American congress, would make it better taste not to enter into subjects of that kind. If the majority of the congress feel otherwise, I personally shall be perfectly contented, because I am convinced, as I said a moment ago, that it can have no possible military significance, so far as the Dominion of Canada is concerned, because we shall never be at war; but even that could be easily overcome by amending the resolution in such a way as to eliminate the military aspect of it, and suggest a National highway, not a military highway, but a National highway, which of course could be used for military purposes, or for any other purposes that a highway is useful for. Now, gentlemen, I want you to understand distinctly that I am not strongly opposed to the resolution, although I question its propriety in a body constituted as this is; because those of us who are from without the United States have come here and have been accorded the privileges of even membership in your association, and we appreciate it; but in view of the constitution of the congress, the questionable propriety of forcing a resolution or even urging a resolution of this kind might very well be considered. It is not a matter of entertaining any fears, and I am willing to defer entirely to your judgment in the matter, but I have expressed my personal views and, I hope, the views that prevail in my part of the country. (Applause.)

MR. COBB: I just want to say that Arizona would not be interested in the construction of this road, any more than Illinois, yet I intend to vote for the resolution for several reasons. The first is that I don't think congress will pay the slightest attention to it. (Applause.) I think it would be pigeon-holed, and even if it was not pigeon-holed and if they did not pay attention to it, I would vote for it, because I believe it is a move in the right direction, and it doesn't make any difference to me or to Arizona where they start building military roads, so long as they start. A third reason that I have for voting for it is because these gentlemen out here on the Pacific coast want us to vote for it, and I think that those three reasons are sufficient for any man to vote for this resolution. (Applause.)

MR. TERRACE: You people from the East, and especially from Illinois (laughter) seem to think that you are perfect-

ly at ease, that you will be the last that ever will be hurt. If you had lived here on the coast when President Roosevelt issued that proclamation that the Japanese children should sit down by the side of the white children; when the people of the coast were looking down the barrel of a Japanese man-of-war and couldn't sleep at nights; with an unfortified coast along three states, without a road to transport your troops, nothing but a howling wilderness, it would have been a different proposition.

This delegate from Arizona says that the congress of the United States will take but very little notice. He never made such a vital mistake in all his life. That is one of the questions, and one of the great questions that will come before congress at this next session. What can we do to prepare ourselves? Do we want to be placed in the same category as England, France, Belgium and all these nations that have been caught unprepared for war? If they had been prepared there would would have been no war. It was because they were not prepared that the greatest war that the world has ever seen is going on today. Prepare for war in time of peace and you will have no war. What is General Kitchener saying to you in your morning papers? He says your forts, the greatest forts of modern times, the greatest forts that engineers could build, cannot stand your modern guns. They avoid these forts. They will land on an outlandish place, where they can make a landing, anywhere along the coast, and you must have roads to transport your troops in case of necessity, from one part of the country to the other.

Let the government give us this land which rightly belongs to us and we will build a road, and we will ask no odds of any of you. (Applause.) But instead of that, sixty per cent. of our states, and the finest part, is held by you people back east, and when we have to make roads we have to make roads with your reservations; and we have to go down into our pockets and build these roads through these reservations, to make connections. Why, it is an outrage. You have spent millions of dollars on the rivers in the east. We have never complained, because you are in the majority. You mean to dictate to us and keep us down. We are only asking for what is our own. Give us the land and we will build the roads. That is all we ask of you. (Applause.)

MR. COBB: Mr. Chairman, pardon me for rising again, but Mr. Terrace put me in the wrong light. I didn't mean that congress would not take cognizance of this great subject, but I meant to imply, or I said they would not pay any attention to this particular resolution from this particular meeting. I believe that congress may take up this subject, but it will take it up on a very broad scale, and when they start building military roads, or any other roads, I believe they

will build them throughout the entire country and not in any one section.

CAPTAIN COGGESHALL: Mr. Chairman, in listening to the remarks of the gentleman from Illinois, it led me to think that I have been identified for a number of years with the harbor improvement of our ports, and all matters relating to improvements on the Pacific coast; and we have noted one thing in reference to the work of the congress. That is, in trying to get bills through relative to harbor improvements, the gentlemen from the middle part of the United States did not seem to have a realization of the fact that our seaports, our harbors here, were very closely allied with their prosperity. The man from the middle part of the United States said he didn't care whether it was twenty feet in Humboldt Bar, or whether it was forty; or whether it was sixteen feet or whether it was forty feet in New York Harbor, but as a matter of fact these details all have a vital interest to every man in the middle part of the United States. But we have found that we have always had their opposition in all these matters.

Now as regards this highway that is proposed—this National military highway for the Pacific coast, I don't think that the gentleman from Illinois has the proper realization of the significance of that road to the people of the United States, himself and his community included. I feel that he thinks that the construction of that road on the Pacific coast is simply perhaps but for the convenience of his fellows who were born here, or couldn't perhaps make a living back East and had to come out here; but I think he is entirely mistaken in that matter. It is of vital interest to the gentleman from Illinois, and to everybody in the middle part of the United States. If any matter came up relative to Mississippi River improvements, or any improvements of roads in the interior of the United States and there was a congress assembled there and the members of that congress who were adjacent to that territory were to recommend a proposition in that territory, I would consider that they had looked the matter up very thoroughly; that they were thoroughly posted on the proposition, and that in putting it up before the congress they had no ulterior motives or personal motives; that they were doing it for the good of the country at large. That is the same condition existing as regards this proposed highway.

The Pacific coast is the gateway to the Orient. I do not think that the people from the interior of the country realize the perils that beset the Pacific coast. I don't think they have a proper realization of the effect an attack upon the Pacific coast would have on the interior of the United States. I feel that on thinking the matter over and giving the mat-

ter proper thought, that the gentleman will come to a realization of the extreme importance of a military road in the extreme west of the United States, whereby transportation may be had quickly between the Mexican line and the Canadian line. On the eastern coast, the Atlantic Seaboard, you can go from Vermont or the Canadian Line, down to Florida Keys. You have several parallel lines of railroads. You can move your population, your troops, your munitions as quickly as you wish to do so. On the Pacific coast we have got a single track of road, practically, running from the Canadian Line to the Mexican Line, and that road in many instances is a long distance in the interior of the states. It would be imperative that we should be able to move up and down on the coast. We simply have no way of moving people or munitions, and I hope to see this resolution carry before this congress, and there should be an investigation by the United States government as to the propriety of establishing such a road.

SOME DELEGATES: Question, question.

CHAIRMAN MAC DONALD: Oh, no. We have all paid our little fare here to this convention. This is the most important thing that has come up, gentlemen. Let us discuss it, and let every one have a fair opportunity.

MR. SUGGS: Mr. Chairman: Some of us have started in this movement years ago, and some of us only lately. There are a number of us who have been working along these lines, spending our money and time for years trying to get something done for uniformity, trying to get the roads of the United States improved. I have been a pioneer. I am a son of a pioneer. I have lived on the border most of my life. I don't know much about the comforts of city life. I was a delegate to the convention at Houston a few years ago, and they asked for a resolution. It was a meeting of the Trans-Mississippi Commercial Congress, and there was a resolution offered asking that fifty million dollars be appropriated for the benefit of the rivers and harbors, to be spent as the committee on rivers and harbors saw proper, without asking congress for an appropriation. I opposed that resolution because I have lived in the interior for years and years. I have lived where it was fifty miles from my railroad depot. I know something about that kind of a life. The government has been spending a great deal of money on railroads. They have not selected any one place, but any road that would go through undeveloped country, the government has been very liberal with. They have also been liberal with rivers and harbors.

I opposed that resolution. I will never support that until they build some way to get to the boat landing. Now building right alongside of the boat landing won't reach the people

of the interior. Gentlemen, I am afraid it will hurt our work to ask for one special road. I am in favor of the government building, owning and maintaining a system of highways. Then I believe the state will follow suit. I think the government ought to set the example. I think the investigating committee, if they will enlarge that resolution, should investigate and look into the building of highways, one from Winnipeg to the Gulf, one from Wilmington or New York to San Francisco. That is all right. That will reach the people of the interior and it will help our cause, but when we build along one line, I am afraid it won't help our cause.

I am as much delighted with the Pacific coast as any visitor here. I have been well entertained, and I feel better by being here, and I know that we will accomplish a great deal. But it seems to me if we were to pass a resolution of that sort, it would hurt the great work we have undertaken along these lines of improving the highways of the United States, and I shall oppose that resolution. I would be ashamed to go home and face my people and tell them that I wanted just one line of road in the United States investigated, and see whether it would be the fair thing. I hope that resolution, for the good of the order, for the good of the whole association, for the good of the country, will not be considered, or that the resolution will be enlarged.

(George W. Tillson then took the Chair.)

MR. MACDONALD: I don't want to be considered as taking advantage of my position as chairman, and so I have asked Brother Tillson to take the chair, while I, the only surviving member of the organizers of the American Road Builders' Association, just say a word. I have always had a very high regard for Mr. Tillson, and never more so than today, when he sat as the chairman of the committee on resolutions. And I remember that the first resolution that was ever passed in the original, the parent organization, the American Road Builders' Association, the mother of all these organizations, was that the American Road Builders' Association is a deliberative body, not a legislative body. And the question that was raised by a gentleman is highly tenable; that we have no right to come here, an organization composed of four different associations representing different conditions and different parts of the country, without going back to our several constitutions and asking them what ought to be the action of each individual association.

So I have always opposed taking any decisive action in a legislative way. I think I quite agree with my friend Gash of Illinois. I was proud of the fact that Brother Tillson ably represented my association in tempering that resolution to read "To inquire into the advisability of." No action binding this convention, or placing the responsibility on that great

legislative body elected by the entire electorate of the United States, can be taken that might govern this great question that is being talked about today.

There were three times in the history of a great people in which three roads did mean something. The old Kings Highway that I had the delightful privilege of finishing, in so far as it went through the state of Connecticut; the old Winchester road, and the road over in Brussels that changed in a moment, in the twinkling of an eye, the map of the world. There is not an American city today in which the blue blood of patriotism runs, but what has hung its head in shame by reason of the fact that we were not prepared and had to stand supinely by and be insulted as a nation because we were not ready to throw the gauntlet down (applause), and when the man in the white house stood up in his might and gave the word, thus far shalt thou go and no farther, then the United States took her position.

Now let me tell you something, as one of the oldest men in this business. No man has known that man longer than I have. I sat at one of the greatest meetings ever held in the City of New York. We have men who speak for good roads, we have men who sing songs about good roads, we have men who tell stories about good roads, we have men who write about good roads, but we don't have a great many men who spend their money and their time for good roads, and I am very glad to say we have such a man in our audience today, Mr. Samuel Hill, of Washington. (Applause.) I would not for one moment, gentlemen, ask you to stultify yourselves or commit yourselves as against what your several constituencies would have you do, but I do believe it is high time to use the farmers' roads; the farmers who have made this country what it is today; the men who built over two hundred miles of these roads over which has grown this great constituency that is respected by the entire world. Their roads have ceased to be local; a new day has dawned, new uses have been put to the old farm road. Why did state aid become necessary? Because these public highways were open, and a public highway once opened, used by the public, should be paid for by the public and out of the public purse. They are ceasing to become local. They have become a state charge, and in my own state I laid out, not one trunk line, but fourteen trunk lines, so as to reach as large a population as possible in my district. So I say that it is high time that when the people come from one part of the country to the other, and these roads are used as they are now generally by everyone, and the states are groaning under the responsibility, with the pride of having as good a system of roads as any other state in this great government, that we should ask the nation to come in and assist us. I don't believe that we

have the right to arrogate to ourselves anything that will suggest a standard demand, but I do believe in the constituency coming to congress and saying, we would like to have you consider this matter. Now if you think it advisable, look into it, and then if you think it wise, to add for military purposes another road in some other place, add to it, gentlemen, a north road, a south road; and it is not a precedent.

We are spending the National money on our national highways today, and it is high time that the government should do something along this line, because these roads are not local any more. They don't even belong to the state. They are national highways. The day never should dawn in which the United States should be put in the menial position which she has occupied during the past year, simply because she was not ready to stand up and defend her rights in the face of the world. So I say, gentlemen, in conclusion, this innocent resolution that commits us to nothing, simply places the matter before our congressmen and our senators to inquire into, is highly proper for this convention, and if I did not think it was so, I wouldn't advocate it. (Applause.)

(James H. MacDonald then resumed the Chair.)

MR. WILSON: I would like to ask the gentleman from Illinois a question. He made a statement entirely new to me, that it is unconstitutional for the United States to build a road. Where did that come from, and where was the decision?

MR. GASH: Mr. Chairman, if the gentleman will read the constitution of the United States and the constitution of the various states, and the decisions upon the question, I think he will find that it is unconstitutional to select any particular road to construct under these various constitutions. It would be special legislation, and it is against the constitution of the United States and the constitutions of the various states that I have investigated, and I have investigated a number, to especially legislate upon any question. For congress to appropriate any amount of money and distribute it among the various states, it would be general legislation. This is virtually asking the United States of America to select one road. Now we want roads coming to the Pacific coast, and if you ever get in trouble on the Pacific coast, there will be millions of boys in the interior of the United States that will shoulder the musket to assist you in repelling any invasion. (Applause.) We have got railroads coming from the east. We have got the Santa Fe, we have got the Southern Pacific, the Denver & Rio Grande, the Union Pacific and the Northern Pacific.

The question was raised here by the gentleman from Canada, which ought to prevail here without further discussion. You ought to lay the question on the table. This is a Pan-

American road congress. Let us proceed parliamentarily according to the rules of law.

CHAIRMAN MAC DONALD: Brother Gash, the gentleman yielded the floor just for you to answer that question.

MR. WILSON: The United States government never built but one road. It built a national highway from Cumberland, Maryland, to Wheeling, West Virginia. It paid its money and surveyed that line into the gentleman's own state as far west as Vandalia. There was not any criticism then about its being unconstitutional. (Applause.)

MR. KENYON: The gentleman was entirely right. The government did build a national road, built it through three or four states. The constitutionality of it was widely discussed at that time, and it was decided that it was constitutional to build a road, because there is a clause in the Constitution that provides that there may be post roads. It does not say military roads; it says post roads. Now if there is one objection to this at all it is the objection to the word military in there. That is all. If it is a National road, it can be used for military purposes and for the defense of the state, and I am strongly in favor of having the road built for the protection of the country. I think we all are. It is absurd to think that we couldn't do it. I want to call your attention to another thing. We are mistaken when we say we can't appropriate for a particular thing. They appropriated so much money for the harbor in San Francisco, and the harbor of New York, and the harbor of Boston. They are made specific items, and we make specific appropriations. The same thing they do for Chicago, and the great lakes, exery one of them, and when they made an appropriation first for the Mississippi river, it was an individual appropriation. They have got a rivers and harbors bill, and in that rivers and harbors bill, whether there is only one mentioned, or a dozen as the necessities of the case require, they make a specific appropriation for each project. Then why don't they make a specific appropriation for roads? Why, they could do it. There isn't any question about that, so far as the law is concerned. Now the thing of it is, we are all in favor of having the nation help build these roads, and the question is to get them started. One thing that strikes me, as I said, is whether that question would not be raised immediately, when you use the word "military," that the constitution said "post-roads." But post-roads belonging to the government could be used for military purposes, and why doesn't it rub out the roughness of it, by just eliminating the word military and putting in the word National. Nearly every one of these organizations have passed resolutions in the past favoring National highways, National roads. Government assistants won't do it. They disagree as to the particular method that should be used, but if we can get them started, or get their attention brought to

it by passing this particular resolution, why I think we ought to do it, by all means.

I agree with the position taken by Mr. Hill and these gentlemen, that it is vastly important to this coast to have a road that could be used for military purposes along this coast. It is not only for the benefit of the coast, it is for the benefit of the whole country, and why not say so? I just make that suggestion. I don't want to, but I am almost tempted to move to amend the resolution by striking out the word "Military," and substituting in its place "National." I believe I will make the motion.

MR. JEWKES: Mr. Chairman, the hour is now 1.35. This is a big question. I would hate to vote wrong on this question, and I hope we will be American, every one of us, and live under the flag. Let us get as many points of view on this question as is possible. Then we can vote intelligently. I would hate to vote against my interests. I would like to hear a little further discussion on this. Could we not properly defer this question on this particular resolution to the close of the day's session, or a little later, or at a special time? I would like to see it voted on well. The hour is late now, and I would like to hear more points of view on this question.

MR. COBB: I just wish to call attention to one thing that has been brought out in this discussion. A few days ago we were discussing the local road, and in some paper or talk it was mentioned, that unless the individual happened to be on the road that was to be built, that he was usually opposed to it. It was very hard to show a narrow-minded man like that that he was going to derive any benefits from the improvement of the road. I think that all here deprecated that position taken by so many citizens when we were considering this road question from a narrow, restricted standpoint of our county or state. They thought that the individual who happened to live off the road ought to be patriotic enough to be in favor of the construction of a main highway. Now when you get to discussing the questions which affect the whole United States, look at the narrow manner in which you view this question. Now the suggestion has been made that we strike out "military road" and put "national road" in there. I think that would be a mistake for this reason. I don't think that there can be any haggling over the question as to where a military road is needed the most in the United States. I don't think that you have any dispute in this gathering at all on that subject. I think that we are all agreed that if there was a military road built, the first one should be built along the Pacific coast.

MR. ROY: This reminds me of one of my experiences a number of years ago when I was just a young voter. I at-

tended a lecture on prohibition, and at the close of the lecture the people at the head of the movement passed a petition in the audience asking for signatures, praying the state legislature to submit to the people of the state an amendment on prohibition. A friend of mine was sitting by the side of me when the petition came along, and passed it right on beyond me. I caught it as it passed and started to append my signature. He said, "You don't want to sign that. You are not in favor of prohibition." "Well," I says, "this petition don't pretend to ask me to say that I am in favor of prohibition. This petition asks me to ask the state legislature to give the people of this state an opportunity to say whether the majority of the voters are in favor of prohibition." I signed the petition. I was not afraid to leave it to the state legislature that was elected to represent the various localities, to say whether an amendment of this kind should be submitted to the people. Now this is the question our chairman brought out, I think, very plainly here; that this is simply a request to have this matter investigated. Then we will have the information coming from the representatives of the different states of this country as to the feasibility of this project. I believe it does not compromise the Pan-American Road Congress.

MR. WILLIAMS: I have not had the experience of some of my friends and colleagues. I have not traveled as widely as they have, but some one has said that a dwarf standing on the shoulder of a giant, can sometimes see farther than the giant. I am the dwarf. While I may not see all the questions that are at issue here, I think from the arguments and discussion there are a few things that might be at least worth bringing out. First, the gentleman here referred to the Old National road. If my memory serves me right, the majority of that was built by the states through which it passed. I think it was built under government direction. We have several roads through West Virginia that were built by the mother state, and at the present time according to some of the decisions of the Supreme Court, it is a mooted question as to how much each of the states should pay. That is a matter of issue. But, my friends, in connection with this question that we are now bringing out, there is a point I think that we should well consider. From my viewpoint the greatest danger, and I mean today the real danger that we are facing as a citizenship, is not the danger of external invasion, but the danger of decay from internal congestion. In order to get around that condition, to build up and keep our citizenship at the proper standard, it is necessary to get that citizenship expanded and distributed properly over the territory.

Take the history of the nations that have failed, the history of those that have gone down in the past, and each of those, when they have failed, have failed from internal decay;

not so much from external invasion. Whenever a nation becomes metropolitan in a majority, right then and there is a danger. Today that old phrase "Westward the course of empire takes its way" is past. We have reached, so far as unexplored and undeveloped country is concerned, a different plane, and at the Golden Gate, my friends, where we are standing today, is the break of the western advancement of civilization. We are standing today where we face a new problem; a new scene in the development not only of this country, but in the entire world's development; and our position therein, and that scene, that change, comes not in conquering new territory, but in making possible a newer life; a different life; a bigger life; a broader life; a stronger citizenship; a better and more patriotic citizenship, within the bounds of the territory that we have already gone over. Now, while I am very much in favor of defending the western coast, I am first in favor of building within the interior, a patriotism and a citizenship that is capable of being transported over any road, whether military, national or local. That is necessary first, and I don't care whether you have a good road or a bad road, if you have not a citizenship back of it built up on the right kind of training; the right kind of nourishment; the right kind of environment, and the right kind of housing, you will have a failure when it comes to a time of need. We need today to look forward to the expanding of our citizenship over a broader area, taking care of the congested condition, and to do that it is necessary to develop our roads in every section of this country at the same time and alike. I am in favor of the road up and down the Pacific coast. I am in favor of another road being built at the foot of the Rockies, on the eastern side; I am in favor of one down the central Mississippi valley, and I am in favor of one down the Western slope of the Alleghenies, if it is necessary; and one down the Atlantic slope, one around the Southern border, one across the center and one across the North. (Applause.) Let us ask the federal government to investigate a broad idea of road building; investigate the idea of building a class of roads that will not only take care of the military, but take care of the homes.

MR. STERN: We have heard a good deal of talk here today about the North, the South, the Middle West. Does it occur to you gentlemen that California, Oregon and Washington are in these United States? (Applause.) It is like the butterfly and the toad. I speak for the toad. This resolution I am heartily in favor of. It asks that congress consider a policy, not the building of a specific road or the expenditure of a single dollar, but that it consider a policy carefully and judiciously. Are you gentlemen of the opposition so afraid of what the United States will say in answer to that

consideration that you would stop even the consideration? We think we know what the answer will be. We think we are vitally interested. We stand here as the captains of the western gate of this country. Some of you smiled a little while ago when we were talking about the possibilities of the western shore. The gentleman from Illinois said that in time of war we will lay down our lives and shed our blood. Why, of course. What in hell is the use of that sort of thing? Over on the other side they are laying down their lives, they are shedding their blood, and they are keeping the stable boys and cripples back to breed a new nation, the men who weren't fit to kill. We will lay down our lives and shed our blood. Yes, but pray God it won't come. Is there anything fanciful about this situation? Here we have a widespread western border. It is not a United States problem alone.

I join with the gentleman from Canada. This Western continent is a thing by itself, a theatre of something bigger, broader and grander than anything this world has ever seen. We have a border line between the United States and the Dominion of Canada thirty-five hundred miles long, and there is not a gun that entire distance to guard that border. While these two countries are working along on slightly different lines we converge at the same place, and one of these days, let me tell the gentleman from Manitoba, we will make you a proposition to change the color scheme and design of the banner in your margin. (Applause.) We stand here guarding and defending the western border against what? Against the other half of the world across there that is yellow that is just awakening to its strength and seeking and looking towards something. It was only a few years ago that a situation developed out here in this country that we had to handle. You gentlemen across the way couldn't understand, because you were too far away, sending out wires, then imploring us. Then you sent the great secretary of state out here to set up an office in Sacramento to tell us what to do. It took a governor with stamina, and a patriotic legislature, to stand here and say to you people in the East who didn't understand, "We know our own business and as captains of the Western gate we are going to care for it." Now, we are here. Our lives, our fortunes and our whole future are here, and we think we understand what we are doing. We are asking just one thing, and that is a chance. We will hold the Western coast of the continent. But withhold our defenses, if you want to, and even though you hide behind the mountain range you will all regret it bitterly. (Applause.)

CHAIRMAN MAC DONALD: Now, gentlemen, I think we have discussed this matter very well. I would like to have the chairman of the committee on resolutions read that resolution all over again, so that you will all understand it.

MR. TILLSON: "Resolved, that the Pan-American Road Congress recommend to the congress of the United States the advisability of investigating the necessity of building a hard-surfaced highway along the Pacific Ocean side, from Mexico to British Columbia, to be used as a military and commercial highway."

JUDGE ALBERT: Mr. President, I move as an amendment, if the committee will accept it, to substitute "National" instead of "military and commercial."

MR. STERN: Mr. President, that is the heart of your amendment. Don't shy at militarism. We have got to come to it. We have reached the day in this United States when we need preparation. Now the minute that you take from that resolution the word "military," then you take the heart from your resolution. (Applause.)

MR. REED: Mr. Chairman, I don't see why the word "military" should be such a bugbear to some of the gentlemen in this convention.

CHAIRMAN MAC DONALD: Did I understand you, Brother Kenyon, to make a motion?

JUDGE ALBERT: I did; if consented to by the chairman of the resolutions committee.

CHAIRMAN MAC DONALD (to Mr. Kenyon): Did you make that as a motion?

MR. KENYON: I did, but I didn't hear it seconded.

JUDGE ALBERT: I have no prejudice against the word "military" myself.

CHAIRMAN MAC DONALD: Then you have no objection to putting the question just as it is.

MR. KENYON: I have no objection to that. It was only because of the legal question that was raised there that I suggested that thought.

CHAIRMAN MAC DONALD: As I understand it, all questions of constitutionality will be passed upon by congress. If the word "military" is in conflict, I hardly think that congress will let it stay there. That thing will be threshed out. The onus is entirely on congress. We simply ask that they set aside time to consider this matter. Do you all understand that?

MR. GASH: Why not make your resolution broad, that the congress of the United States investigate the advisability of establishing a system of national highways as the gentleman here from West Virginia suggested? It is too narrow. We are just as patriotic to California as you are, but while we are patriotic to California, we are patriotic to the Mississippi valley and to the Eastern seaboard. Make the investigation general, not special.

CHAIRMAN MAC DONALD: I have no authority under the general rule which has been adopted at all our congresses

to change the general tenor of any resolution that comes to me, except it has been passed upon regularly and presented to me in a resolution from the committee. I would have to refer it back, and I think we can get the temper of all the delegates by putting this to a vote. If it is voted down, then there are some other methods to be pursued, and it will have to be referred back to the committee on resolutions.

MR. COBB: I wish to offer a suggestion to Mr. Gash, that if he would draw his resolution, I have no doubt it would receive the unanimous approval of this meeting. I think the word "military" should remain in the resolution.

Mr. GASH: Make your resolution read that the congress of the United States investigate as to the establishment of a system in national highways, and they can be used for military or any other purpose that the government of the United States wishes to use them for. The government of the United States, if it is necessary, can use the railroads for military purposes; it can use everything for military purposes if it is necessary.

MR. EDDY: The government has the right to appropriate land for military purposes, and that can be their authority for that proposition.

CHAIRMAN MACDONALD: If you gentlemen will wait just a moment, until we get this matter presented to the convention intelligently, so that we can understand it, then we will debate it from that standpoint, but I had understood that we had gone over this whole matter and we were ready for a vote.

MR. JEWKES: I would like to vote on this question. I would like to favor the gentleman from Illinois to this extent, that we ask congress to establish a system of highways and to investigate the advisability of a military road connecting Canada on the north and Mexico on the south, along the Pacific coast. I would like to vote on a proposition of that kind.

JUDGE ALBERT: I would like to say one word. It is pretty hard to amend the report of the committee. You are putting words into their mouths. I don't believe any amendment is proper unless adopted by that body. In that case I think it would be better to refer it back to the committee. But every American citizen is said to be a constitutional lawyer. There has been a good deal said on this question, which reminds me of a decision made recently. A man was sentenced to be hanged in Portland, and he appealed the decision to the supreme court of the state. The time was set for his execution. The supreme court didn't consider the case until after the man was hanged, so the hanging was void in effect, but it didn't restore him to life. Now, roads have been built by the government.

They are building them now in Alaska. The roads were brought to this coast in that manner. A railroad was built fifty years ago and Milton Lathom took the bonds of the Oregon-California Railroad and sold them in Germany. Afterwards the road failed. The road carried out its part of the project, but now we are trying to repudiate our part. We want to take them away from them.

DR. PRATT: I think the main question of dispute amongst the members, especially from the eastern states, and perhaps the middle western states, and some from the western states, has been in the national road congresses that have been held earlier. The question has come up in regard to the congress recommending or adopting resolutions relating solely and particularly to any one particular highway, as, for instance, in the east when they tried to get the Lincoln highway and the Jackson highway. Personally, I am very much in favor of a highway such as is recommended here in this resolution. I am personally in favor of it from a military standpoint, not simply because I belong to the National Guard, but I believe we could remove the objections that many have to this if we would insert in the last portion of that resolution a few words so that the resolution would read something as follows: "Resolved, that the Pan-American Road Congress recommend to the congress of the United States the advisability of investigating the necessity of building a hard-surfaced highway along the Pacific Coast from Mexico to British Columbia, and other national highways to be used as military and commercial highways." I suggest that as an amendment.

MR. HILL: I second the amendment.

CHAIRMAN MAC DONALD: Gentlemen, you have heard the amendment. All in favor of the amendment as read, please say aye. Opposed, no. The amendment is carried. (Applause.) The question recurs to the original motion as amended. All in favor of the original motion as amended please say aye. Opposed, no. The report of the committee is adopted and the resolution passed. (Applause.)

MR. TILLSON: Mr. Chairman, I don't think I have any more bombshells. "Resolved, That the Pan-American Road Congress hereby desires to express its thanks for the courtesies extended to it by the press of Oakland and San Francisco in reporting the proceedings of the congress, so that the same might become public."

MR. ROY: I move the adoption of the resolution.

MR. KENYON: I second the motion:

CHAIRMAN MAC DONALD: All those in favor of the adoption of this resolution will say aye; opposed, no. The resolution is adopted, and we will have the next one read by the chairman of the committee.

MR. TILLSON: "Resolved, That the Pan-American Road Congress expresses its keen appreciation of the hearty co-operation of the Chamber of Commerce of the city of Oakland for the great interest it has taken in the proceedings of the congress and the general cause of good roads, and the many courtesies extended to the delegates of the congress, which has contributed so much to the success of the meeting.

JUDGE ALBERT: I move the adoption of the resolution.

MR. COBB: I second the motion.

CHAIRMAN MAC DONALD: All those in favor of the adoption of this resolution will say aye; opposed, no. The resolution is unanimously adopted.

MR. TILLSON: "Resolved, That the Pan-American Road Congress expresses its deep gratification for the courtesies and assistance given this convention by the officials of the Panama-Pacific International Exposition."

MR. KENYON: I move the adoption of the resolution.

MR. TERRACE: I second the motion.

CHAIRMAN MAC DONALD: All those in favor of the adoption of the resolution will say aye; opposed, no. The motion is carried.

MR. TILLSON: "Resolved, That the Pan-American Congress expresses its sincere thanks to the state of California and the county of Alameda, the cities of Oakland and San Francisco for the courtesies which they have extended to the congress and which have been especially enjoyed by the members in attendance at this convention.

JUDGE ALBERT: I move the adoption of the resolution by a rising vote.

MR. KENYON: I second the motion.

CHAIRMAN MAC DONALD: You have all heard the motion that this resolution be adopted by a rising vote. All in favor please rise. The resolution is carried unanimously.

MR. GASH: I move that when we adjourn we adjourn until three o'clock.

MR. HILL: I second the motion.

THE CHAIRMAN: It has been moved and seconded that we adjourn until three o'clock. All those in favor please say aye; opposed, no. The motion is carried, and we will adjourn until three o'clock.

(Adjournment.)

SEVENTH SESSION—3:00 P. M.

JAMES H. MAC DONALD: We are just a little late on the program time, but we didn't get out of here until after two o'clock so I guess we will be pardoned in starting an hour later. The gentleman who will preside over the delib-

crations this afternoon brings to my mind early memories of the days in which the bicycle was the silent steed. I can remember what a time I had in my state where the bicycle young men wanted to have me build a bicycle path through the state eighteen inches wide and have superintendents look after it. What a time I had with those boys trying to get them to widen out the eighteen inches to eighteen feet, but we finally did and then came the automobile. I remember delivering an address in Boston in the Tremont temple, and my subject was "The City Street and the Country Road." I devoted my entire time to talking about the wheel and the hoof, the two destructive elements of the road. I never alluded—and that is only twelve years ago—I never alluded even in passing to the word automobile.

Here is a great organization which has grown up all over the United States, I think a hundred thousand members, Brother Wilson, in forty odd states, a tremendous force; something to be reckoned with. Now, I know that we can have an interesting session. You know all of us commissioners have gotten a little awry sometimes with the automobile and a good deal of that was due to the fact that we didn't know very much about the automobile. But we are getting so now it is not a rich man's toy; it is the poor man's friend. I know you will all be glad to have the president of that great organization of a hundred thousand members scattered through forty-one states address you this afternoon and be your presiding officer. Take all the time you want until the rest of them come in, and tell us a little about the industry. (Applause.)

(John A. Wilson took the Chair.)

Address by Chairman Wilson

I don't know much about the industry, but the growth of it has been wonderful. When I sat over at the fair yesterday I heard the gentlemen throw bouquets at themselves talking about what they had done in their organizations for good roads, and when they were organized they were children. When they were organized we were old men in the business. I think that the organization today of the American Automobile Association has done more as a booster for good roads than all the state organizations that have ever been formed, for this reason: We are for any person or any body of men in any section of the United States that will build a mile of road. Now, we don't care how that mile of road is built. Of course, the taxpayers must look after the idea of getting a dollar's worth of road for every dollar they put in. Another thing we are in favor of: We are in favor of this national government of ours giving the same aid to the farmers that they give to the steamboat men. They have the same right to build highways across this country,

up and down and east and west, wherever they build them, as they have to improve waterways. We are for good roads. Our organization comprises forty-one states; over seven hundred clubs, a voluntary organization. Everybody in it is pulling for the best that there is in the game. Another thing we are in favor of: After the roads are built we are in favor of the safe and sane use of those roads. We are opposed, and bitterly opposed, to using the highways of the different states for speed exhibitions; for the trying out of cars driving from Philadelphia to Pittsburgh, three hundred and four miles, nine hours. "Get out of the road. The last car I met kept me back."

Our object in good roads building is to enable the farmer in our state to get to market. It is not like California, not like Florida, where they are not troubled by weather, for usually with us in Pennsylvania we are tied up about six months in the year so that we can't move a wheel unless we have got something under us; and the same is true in New York state. We are trying to build roads that will enable the farmer of the United States to get to the market twelve months in the year instead of six months in the year; with twice the load in half the time. It is costing the people of the United States over a thousand million dollars every year,—every three hundred sixty-five days,—for the lack of good transportation. It is costing you, and you, and you. You are paying for it on your table; you are paying for it in wear and tear, in everything.

Now, organization is a great thing. That was shown last year when there was an effort being made, you remember, when they tried to tax gasoline and the automobiles through the national congress. Well, there was a hue and cry that went up from the farmers. Eighty per cent of the automobiles that are sold in the United States today are sold to farmers, and it is not a rich man's car. The farmer uses it during the day for his work and on Sunday he takes his family for a ride. He has two bodies for his little car. A little Ford is all right. Henry Ford has done a great deal for this world of ours and all these jokes about the Ford he enjoys as much as anybody; but we have to guard the roads after we have them.

I had supposed that the worst traffic laws that I had ever run across were in Paris. I supposed that Paris was the only city in the world where the rights of the users of the sidewalk, the people who are compelled to walk, were not safe-guarded, until I struck San Francisco. I will tell you that the traffic regulations in San Francisco would make a Frenchman laugh. I never have seen anything like it, such an utter disregard of the rights of everybody; and where

as much latitude is given to drivers,—all kinds of machines,—as right over here in San Francisco.

I am not timid. I am not timid about riding any place. I will go just as fast as anybody can turn the wheel, if the road is safe, if we don't come to cross roads and don't interfere with any person except ourselves. But where we interfere with the rights of the other people we haven't the right to do it; but I tell you that I have my toes dug in the bottom of the taxicab over here in San Francisco every minute that I am in it. It is a shame, and I wish the president of the Automobile Club of California could listen to it. Billy Hewson is one of these men who will talk of the wonderful things that they do in California and they do in the West, but get busy and see to it that things are properly run and that the rights of the people are safeguarded.

Over at the convention yesterday we had the gentleman who represented the Panama-Pacific International Exposition tell us about the four hundred million dollars that was spent building the Panama canal; but four hundred million dollars were spent for building up San Francisco. In 1913 and 1914 there was spent in the United States $408,000,000 for improved roads, and we built in those two years more miles of road than they have got in that great republic of France that everybody talks about. They talk about the improved roads over there. You start in at Buffalo and go to Boston, down around the Cape Cod, along the sound to New York, back up to Albany and up through the Adirondacks to the King's Highway to Montreal, and you have got the most perfect system of highways in the world today, bar none. I don't care what country you go in. I think I have spent as much time in foreign countries as anybody. I have crossed the ocean seventy-six times in the last twenty-two years. I was over there this spring. I wish I could have stayed longer because people were very busy.

But they do things over here better than they do any other place. We build better cars here than they do anywhere else. We have got more brains here than they have got any place else. But unless we all get together, this organization we have here today, bringing people from all over the United States; unless we go down and knock at the gates of congress with one proposition there will not be the force and influence there might be.

The people from our part of the country are too prone to think that California is like Pennsylvania or like New York. New York has issued one hundred million dollars of bonds for good roads. Proportionate sums have been issued in Massachusetts, Connecticut, New Jersey, and they are working in Maine to the extent of the money that they have there. They have issued or have authorized the issue

of eighteen million dollars in California. Now, California is as large as Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Pennsylvania, Delaware and nearly all of Maryland put together. They expect to build a system of highways in a territory like this,—an empire you might say,—for eighteen million dollars, where that wouldn't build the roads in the little state of Connecticut. Now, there has got to be aid from some place. On the north they have two states, Oregon and Washington. When it comes to size it would make my great state of Pennsylvania, and New York, look like a plugged nickel; they would hardly fill up a corner. Texas, it would take five states like New York to equal its size, and then we kick about the government of the United States building a highway here. Let them build two highways. Let them build three.

Some years ago when Uncle Joe Cannon was speaker of the house, I went down there to try to sound the sentiment and see what we could do about getting an appropriation. In those days the speaker of the house was boss, and what he said went and what he allowed other people to say went. I was back in the speaker's room and I told him what I wanted to talk to him about. He put that cigar up in the corner of his mouth, "Why," he says, "Heavenly Father, John, if you automobile people get your fingers in the treasury of the United States the first thing we know you will have it in to the elbow and then you will have it in to the shoulder." I said, "Uncle Joe, that is just exactly what we propose to do, and when we get it in to the shoulder we are going to keep it there." We have the same rights, the same constitutional rights, in this great big government of ours, to build highways as they have to put up levees and open up streams in the United States for the use of steamboats."

When the President of the United States was governor of New Jersey, at the meeting of the American Automobile Association in Atlantic City, he made one statement, and it is very true, he says, "It doesn't do the United States very much good to make appropriations of hundreds of thousands of dollars to enable the farmer to double the output of the farm unless the same government gives him some way of getting that produce to market." Now, if that isn't sense I would like to know what is.

Now, if you will all pull for one thing, we will all pull for roads. We don't care where they are; we don't care where you get them. Why, up here in Oregon they raised by taxation in Multnomah county, where Portland is situated, $750,000 by direct taxation, and they put that $750,000 in a roadway from the Dalles down to Portland. They have

$75,000 worth of concrete. Up in Montana I rode over some roads with Matthewson just to see what the roads were, and what they have done or have been able to do in that state. They took me for a little ride around in one car in the morning and I had to get a different driver in the afternoon because I guess it was too fast. We drove over 121 miles of as pretty surfaced roads as I have ever driven over in my life. The roads were twenty to twenty-eight feet wide. We drove 121 miles, made three stops, to see the elephant cross the river, one stop at the fish hatcheries and we made that run in five minutes over three hours. Now, those roads cost them in Montana,—with eight-hour days, four dollars a day,—cost them less than five hundred dollars a mile. They have got a first-class road material up there. They use a disintegrated granite. They have a double scraper that they run over the road.

MR. MACDONALD: God built the road and they put it in shape.

CHAIRMAN WILSON: But that road hadn't been touched that spring. There was not a grade on that road of over five per cent. I will tell you another thing that we have done. Yosemite Park has been opened for automobiles. Yellowstone Park was opened the first day of August for the use of automobiles. Over five hundred automobiles went through Yellowstone Park last month and it took us two years to convince the department of the interior that the two million users of automobiles in the United States had some rights they were bound to respect. The whole thing hinged upon the idea that by permitting automobiles to go through the park the people wouldn't stay long enough, would not use the wagons, and so on.

Over at Old Faithful Inn the other evening a gentleman was giving a lecture on Yellowstone Park. One of the pictures thrown on the canvas was a stage leaving Old Faithful Inn. He made the statement that that was the only kind of transportation authorized by the government of the United States to be used in Yellowstone Park. I came pretty nearly getting up in the audience and saying something to him. I haven't the best temper, but I waited until they were all out, and then I asked him what he meant by it. "Oh," he says, "they are experimenting." I says, "They opened the park the first of August to automobiles," and to that he replied that they were experimenting to see how it would turn out. I said, "Are you interested in the hotel, wagons or horses that are in there." He didn't reply to that. I asked him if he was a gambler, if he wanted to bet. I wanted to bet him that by this time next year there would not be a horse-drawn vehicle in Yellowstone Park. I believe that the receipts of the hotel will be increased. In

other places in this big country of ours they have stopped the automobile, but we have gotten in. I tell you we have got an organization.

A year ago when they attempted to put a government tax on automobiles and gasoline we had that killed at Washington before other people got busy, before they knew anything about it. We had the promise that it would not go through. Of course, it doesn't amount to very much, but there are a whole lot of us, and in that state of Pennsylvania of ours when we start to do anything we do it because they are afraid of us. We use our organization at the ballot; we use it every place we want to.

I remember, as a boy, listening in my home town to a political speaker in the court house. He was a good talker. I don't know whether he was a Republican or a Democrat, but he was very much disgruntled evidently with Pennsylvania farmers, and he old this story. He said he had a dream and he dreamt he went to hell, and before he was ushered into his place of everlasting torment, His Satanic Majesty sent for a guide to show him every place, and finally he came to a room, and said he couldn't see the end of it. In courses there was a series of hooks such as you see in a meat shop and on each one of these hooks was a cadaver. He looked at them and then turned around to his guide and asked, "Are these people up here?" The guide said, "Oh, yes, they are Pennsylvania farmers. They are so damn green we have got to dry them before they will burn." (Laughter and applause.)

The questions to be taken up this afternoon for discussion are "Motor Traffic: Its Development, Trend and Effects." The paper was to have been read by Mr. Elmer Thompson, secretary of the Automobile Club of America. He renigged. Warren Gould, chairman of the Automobile Club of Seattle, Washington, was to open the discussion, but I understand he is not here.

MR. MACDONALD: He has sent in a paper which will be read by title and printed in the proceedings. Mr. Willoughby will read it by title.

MR. WILLOUGHBY: "Motor Traffic; Its Development, Trend and Effects," discussion by Warren Gould, Seattle.

Motor Traffic, Its Development, Trend and Effects

By A. WARREN GOULD

Chairman Good Roads Committee, Seattle Automobile Club, Seattle, Wash.

Mr. Chairman, Members of the Convention and Visitors:

The subject assigned me appears very large for one not engaged in the manufacture or sale of Motor Trucks; therefore, if I treat it in a general way, without definite statistics, and leave the latter to be supplied by those who follow in

the general discussion, you will please bear in mind that I am only an observer.

Those of you who can remember the beginning of railroad building in this country, will readily recall the little locomotive and crudely constructed box cars, first engaged in transporting freight, and no doubt have marked the wonderful evolution which has followed, until today we look with admiration upon those giant moguls, samples of which are on exhibition across the bay.

Hauling cars that are models of convenience, with every known device for safeguarding and protecting goods in transit, they cross and recross the continent without exciting wonder, and serve the people, making possible our large cities of the interior, which otherwise would not exist.

I make reference to this phase of our transportation development, that you may the more readily understand that what I dare to predict for the Motor Truck in the future, is not a pipe dream, born of a large imagination running wild, in the high gear, gas full on, spark advanced and with a defective steering gear; but a parallel that can be grasped, and by a progressive program brought to fruition.

Unlike railroad building, which in this country, has been left almost entirely to private enterprise, no new governmental policy is required to construct highways for the Motor Truck, for with the exception of a few toll roads, now almost a thing of the past, public highways have been built by the people, and if as we still believe and trust, we are, as spoken by the immortal Lincoln a "government of the people, by the people, for the people," we should go forward pressing for greater development, even to the extent of the semi-military highway, if you please, constructed by our Federal Government for the benefit of the Nation.

With a proper conception of our possibilities and a knowledge of the high purpose of the determined men and women represented in this convention, I predict that the Motor Truck within the next decade will play as important a part in transportation as the railroads.

In support of this prediction, I can safely state that the Motor Truck has, since its introduction, in the past ten years, developed to double the degree of efficiency as did the railways in the same length of time after their coming into use; and today its use is making possible development in remote places that would otherwise be impossible.

In automobile tours covering the Western portion of our country, I have often met on the road caravans of horse-drawn vehicles, and though their equipment was modern, their pace reasonably, and to a certain degree rapid, when compared with travel in India or China in olden times, how quickly this is changing through the introduction of the Motor Truck.

Many vexatious problems confronting the officials of our large cities have been, and are being solved by its use. New York City wrestled for some time with congestion of traffic on its water front, and only a short time ago contemplated changes in streets, by widening, etc., which would have cost millions of dollars. While figuring ways and means for making the improvements, along came the Motor Truck, which, due to its efficiency, eliminated the congestion and rendered unnecessary this enormous expense and increase of the taxpayers' burden.

The great and commendable effort being made to improve the milk supply in cities, is aided more by the Motor Truck than by any other agency. If I may be pardoned for localizing, the City of Seattle, where infant mortality is lower than in any other city in the world, recently put into effect new regulations and requirements which would be impossible of enforcement without the Motor Truck.

It is a well-known fact, that almost every fire that destroys our buildings could be extinguished by hand apparatus, if reached within five minutes from time of starting; and this is now being accomplished, to a large degree, by use of the Motor Truck. Buildings just outside the limits of cities using motor truck fire apparatus, receive lower insurance rates. Insurance companies are maintaining, at their own expense, private motor trucks, capable of great speed, equipped with fire-fighting implements to protect lives and valuables in buildings insured by them.

At the present time, when conditions tend to discourage investment in railroads, the Motor Truck is coming to the fore and settling troublesome problems of transportation. One of the many instances of this is found in Nevada, where a rich copper mine twenty-five miles from Currie, abandoned fifteen years ago, owing to the prohibitive cost of mule-team hauling, is now profitably operated by use of the Motor Truck.

From the foregoing it must be patent to everybody, that the Motor Truck is a real factor to be reckoned with, but like a great ocean-going freight ship, with no sea to sail upon, it may count for little, unless our government constructs highways over which it can be operated.

The cities, with their brick paved streets, furnished the opportunity for demonstrating its success; and the counties and states have contributed through paved highways. The broad sea of commercial achievement cannot be one of mud, but must be ribbons of permanently constructed roads, on concrete foundations, paved with brick, as are the roads of Western Washington (second to none) capable of sustaining great loads, stretching from city to city and state to state, from ocean to ocean, and northern boundary to southern

boundary of the entire country. Such highways are possible, and will prove profitable, when ignorance can be supplanted by intelligence, and wastefulness by thrift.

The Pacific Coast is in sore need, and the same is no doubt true of other sections, of a permanent paved highway from the Canadian border to Mexico, located along the shore, where it will be free from frost or snow and can be used every day in the year.

The European war has demonstrated another use for the Motor Truck, which God forbid our country should ever need to follow. But should such a contingency arise, is it not better to consider, when planning means of defense, highways calculated to provide practical means of transportation in time of war, while unlike the costly navy with no commercial value, they would prove profitable in time of peace; and instead of an increasing burden, would tend to develop and bring greater peace and prosperity to our people?

In conclusion, I do not hesitate to state, that in the counties of California alone, through which a Pacific Coast road would lie, there are natural resources, undeveloped, that would warrant the expenditure of double its cost for the entire length from border to border.

CHAIRMAN WILSON: The next gentleman is Mr. Chanslor, San Francisco. Is he present? Now, if there is any gentleman here who would like to be heard on that question I would like to hear from him, because there is an awful lot to be said.

MR. KENYON: The time is short and I think there is one matter in this connection that ought to be presented. I will give a little outline of it and if they care to afterwards when they come to print the proceedings, and want me to, I will prepare a little more definite statement than I can make in the short time that we have got now. But I will give a little outline of a thought that I had.

I looked over this program from one end to the other. I was personally amazed to find that there is no suggestion of what we might call "safety first" in this great congress. There is no paper, there is no place for discussion, unless it is at this place where we are discussing it. You can't but be apprised, of course, of the appalling number of accidents that are occurring in the streets and on our highways every year. This morning's paper contained an account of two accidents and yesterday's paper contained another, and every paper contains one or more, and it is not only that way here, but it is that way all over the country. What are we doing to stop it? I was in London at the road congress, two or three years ago, and after the congress was over, and while I was still there, a parliamentary committee

made a report on this question of safety. They had been studying the question for two years, making extensive examinations into the number of deaths and accidents. There had been prior to that time no one to gather statistics about that. They discovered that in the city of London alone 125,000 people had been killed and injured in the last eight years. They got that information only from the police and other reports, and many were not recorded. That is just in the city of London, not to speak of those that occur outside. We have no means in this country of doing it, but they immediately commenced to take notice of this tremendous loss of life. We get awfully wrought up if some few people are killed on board a ship, but here they are being killed by the dozens and hundreds every day and we take it as a sort of matter of course. Now, it seems to me that the road men, men interested in roads, should be profoundly interested in it, and should do something on this subject. It seems to me that they ought to commence studying what can be done and what should be done. Congressman Rainey ran through papers and one thing and another discovered last year, as he said in his speech in congress, over two thousand people killed in less than six months, and yet we go on thinking nothing about it. Is it not appalling? Yet some way or other we don't do much in regard to it. Now, I just throw that out as a suggestion, and it seems to me that it ought to be in every road convention. There ought to be a safety first program or a day or a time for discussing that subject, and we ought to do something.

Now, what could we do? In the first place, I ask, why should not every state that has a highway department have a "safety first" commissioner, we will say? We will call him a Public Safety Commissioner; someone upon whom we can place the responsibility for looking after these things, someone who will do something. The engineer is busy with his duties; the commissioners are busy with theirs and unless you concentrate that responsibility in the hands of some one man who will study it and work it out, you are not going to get any results. What could he do? He could get statistics; he ought to have police powers, and other powers too. In that connection he could make rules and regulations. Now, in England, if a road is going to be closed, or if there is going to be a big parade on a certain road, their public commissioner has the right to make rules and regulations that can be enforced and punishment administered if they are violated. Now, a commissioner here ought to have powers of that sort. He could also have the power of saying in every contract that is let for public work, that there should be some provision made for safety signs where they are needed, or for safety fences where they are needed. That is done in some states.

Down in Mr. MacDonald's state where there was a dangerous place on a part of the road they put in the contract that it was a part of the road that a fence should be built,—a good substantial fence that would save damages. But why shouldn't it be in every one, whether it is Connecticut, New York, California, or Oregon or what other state? We are not doing it, and dangerous places are at every hand. Signs at crossings. Why, the railroad companies say, "We put up railroad crossing signs," but remember that it is many times within ten feet of the place where the train crosses. They have no powers at present to require signs. It may be there happens to be a bunch of vegetation or trees or bushes to obstruct the view. There is no one with the duty or power to cut that down, or to widen the corner, or anything of that sort. Ought that not to be a part of it? The placing of these danger signs, why isn't it put in the hands of the commissioner, the engineer, who has studied that road and knows it better than some chance advertiser; or it may be the automobile association who goes out voluntarily and puts up a sign. Why isn't that just as much a part of the road as the road bed itself?

I just throw that out as a suggestion because I am running along. What are the causes of most of these accidents that they found over there? They found out first that the negligence of the pedestrians crossing the road was one of the great causes. Just think of it. I rode twenty-five hundred miles over the highway in Great Britain and in that entire time I crossed the railroad but five times at grade. It was either over or under, and for those five times someone had to come out and open the gate before we could get across. This was to insure our safety. And yet here are streets and roads that are on level grade crossings all the time and we pay no attention to it. We put a policeman at grade crossings on our busy streets and then not one of us pays much attention to him. Why? Because they haven't got any other powers than to direct this way or that, and they don't punish if we fail to follow their direction. In Paris they passed a regulation providing that the man who was run over was to be arrested instead of the driver. I thought that was a rather strange thing. I went down to what we might call the Office of Public Roads to enquire about it, and he said, "Well, think of this. That man who was driving that vehicle, maybe it is a three-horse vehicle, has got three big brutes to look after. He has got to keep himself in control and look after twenty passengers inside, and then you want to place upon him the responsibility of looking after the individual pedestrian on the street besides. Don't you think it is rather overburdening that one man?" The result of it

was the cutting down of accidents the first year, by putting that regulation into effect, almost fifty per cent. They could arrest the man who was hurt. They didn't just have the opportunity of warning him, but if you saw a man going across the street you could identify that man and go and get out an affidavit and prosecute him.

It was only a little time until they brought the realization to the people that it was important and necessary for them not to cross the streets in the middle of the block, but to go down to the corner where they could be protected by having the busses and vehicles stop, in order that they could get by; and then, in order that the responsibility would not be on the driver, when they notified the people to stop, they had to stop on the sidewalk, not in the street and dodge in between the vehicles. Then, of course, there is a certain number of careless drivers. They have no speed limits in Paris, for example, only the limits of safety. They don't say eight miles or ten miles or fifteen miles an hour. A driver could drive forty miles an hour, but let that man once violate the law or hurt anybody and his license is taken away from him, and thereafter his occupation is gone. He is not permitted to get another. The result of it is that it makes every driver doubly careful.

Another thing, they don't permit anyone to drive a vehicle, whether it is a boy or girl or owner, or someone else, without having passed an examination and getting a license to show that they are competent to do it. They look after it on that side. Why shouldn't a public safety commissioner begin to look after these things? Furthermore, they go to the extent of educating the people by signs in all the busses and in all the underground cars, and you are flooded with the little pamphlets everywhere, and they are in the schools, too. Why couldn't those public safety commissioners commence taking that up with little pamphlets, and get it into the schools, to teach the people to be careful? You have got to make it a part of their life, yet we Americans have so little regard for those things, at least we are willing to take so many chances that these accidents occur every day.

We all want to get ahead. They found out in that examination in London, that one of the greatest causes of accidents was that of a team jumping out and passing another team, you know. The man that attempted to cross the street would find another team jumping out across to get ahead, so that team would just catch the man who was a watchful pedestrian, maybe, just as he was trying to avoid that machine. So they cut that out. Well, then there is another thing that we do, that they have stopped, which cut the accidents on the English roads almost in two. That was the

driving in the middle of the road. You know they have a great many winding roads, high fences and hedges over there, which prevent you from seeing across the corner. They are cutting lots of these corners away, and you can circle around with a good view ahead; but the road is wide enough for two teams. Any man who is caught driving in the center of the road is subject to arrest at any time. They find that by having the man drive at the side of the road, even if he does happen to be going fast in going around a corner, every one is on his side of the road and an accident is prevented. With us, by being in the middle of the road, it would just bring an accident on, and you know how difficult it is for any of us to keep on the side of the road when we don't see anyone immediately in front. We don't realize the rapidity with which a vehicle coming at the rate of forty or fifty miles an hour will reach us.

A train will come out of a bunch of timber, or from behind a fence, and it is on you in a moment and you have no chance. You might get out and look and all that, and this public safety commissioner could be looking after that to see that others looked ahead. Men are not hurt where you can see the train coming a half a mile either way. That isn't where you get hurt. It is these other hidden places, where they have not an unobstructed look ahead.

CHAIRMAN WILSON: Mr. Kenyon, excuse me for interrupting you, but we only have about six miuntes. We must close at four o'clock, but whatever time is left I will let you have.

MR. KENYON: I will be through in just a minute. There is just one other thing I have got here. There are defects in the road that you all understand, which are largely matters of repair, but engineering signs will tend to correct the defects. Next is the matter I spoke of a moment ago of unskilled drivers. Now, they have the power to co-operate with the police, and in this additional feature wouldn't it be a great thing for the benefit of the public and the community, and ought it not to be done by every highway commission, every county commission or county officers? There ought to be some man whose duty it is, it seems to me, to look after this matter of public safety, and spread that propaganda and get it into the schools, and public advertisements, and pamphlets and so on. What a wonderful work it could do, and what a supplement to the work that you are doing, and really a part of your work, is it not? (Applause.)

CHAIRMAN WILSON: Mr. Kenyon, in all of our states east, like Connecticut, New York, New Jersey, Pennsylvania and Delaware, the state highway commissioner has a right and exercises his right and authority to cancel any man's

right to drive on the highways, who has been convicted of careless or reckless driving. They exercise that right. You referred to the notice to be sent to school children. That was inaugurated by Dr. Rowe, of Baltimore, Maryland, and he has had at his own expense probably 500,000 of those little things printed and sent out around to the school commissioners of the eastern cities, to be distributed among the school children.

MR. KENYON: There is not one of them here.

CHAIRMAN WILSON: I know they are not here, but I am talking about what he has done himself. In the east it is just as much the part of a contract to put a guard-rail and a sign-board up as it is to put the foundations in for the road.

MR. KENYON: There are five states you have spoken of, and you must remember we have forty-six or forty-eight.

CHAIRMAN WILSON: I am talking about the ones that have come under my own observation, the ones that I know of. Another thing we are going to have, we are going to bring Canada so close to us that we can drive across the line without having to change our tags any more than we have to change them in driving through New York or Pennsylvania. Dick Lee, of Cleveland, who is the chairman of our legislative committee, told me the last time I saw him that he thought we would have that inaugurated this fall, so that by next year we could drive over to Canada exactly the same as we drive between our own states.

MR. REED: I would like to say a word against your side. In the state of Washington there was a law providing for a speed limit of twenty-four miles, and the Automobile Association got it increased to thirty.

CHAIRMAN WILSON: They got it increased to thirty? Was there any objection to that?

MR. REED: Surely.

CHAIRMAN WILSON: Will you tell me some man that doesn't drive thirty miles an hour?

MR. REED: Why should he?

CHAIRMAN WILSON: That is it.

MR. REED: Twenty-four miles an hour is sufficiently rapid.

CHAIRMAN WILSON: It is, and I would not differ with you on that at all.

MR. REED: Now, then, why enlarge it to thirty, if the law says twenty-four miles an hour?

CHAIRMAN WILSON: I would like to find a man that drives an automobile that won't go thirty miles an hour where he can, providing it doesn't interfere with somebody else.

MR. REED: We have in our state that law which was

twenty-four and now thirty. It is up to the county commissioner to regulate these things. We can put upon the road a limit, limiting any part of the road to any speed whatsoever. For instance, on short turns we can put up signs that the speed limit here is seven miles an hour or ten miles an hour, and we can enforce it by penalty. The difficulty of a penalty is this: Every judge is elected. Every judge is afraid of losing votes, and he makes a small penalty. If I were a judge and I had the penalties to lay down for the breaking of any law, I would make them large. If you would fine a man a hundred dollars or five hundred dollars for exceeding the speed limit, he wouldn't break it the second time; whereas, if you fine him five dollars or ten dollars, he goes ahead and keeps on breaking it.

CHAIRMAN WILSON: That puts me in mind of a friend of mine who was talking on the temperance question once. He said he was in favor of whenever a man got drunk to cut off one of his ears. I said to him, "Why, that wouldn't be right. It wouldn't be nice, because there would be a devil of a lot of nice fellows going around with only one ear."

MR. REED: That reminds me of another statement. I used to be a banker. In China they have a law which says to the effect that when a bank fails, they know in advance they are going to fail. They know a long ways ahead how many bad loans they have, except, of course, in a general panic when you can't pay off all your depositors at one time. In China, if a bank fails, they cut off the head of the manager, and there hasn't been a bank failure there for a hundred years.

MR. BUTLER: This question of safety first is one that I believe this body of men should give particular attention to, from the fact that they come from the various sections of the United States, and everybody is interested in the question of accident prevention. I will only take a moment of your time, but my work is along lines that brings me in contact with traffic accidents. I am safe in saying that ninety per cent of all traffic accidents are due either to carelessness or ignorance of the laws and regulations governing traffic. If uniform traffic laws were enacted throughout the United States, so that a man would be just as much at home in driving in New York as he is in California, and all obeyed those laws, we would not have the accidents that we do.

The sudden thrusting of the motor vehicle into general use, and its rapid growth and increase on the streets and roads of the country, has increased accidents at a very excessive rate, as compared with other vehicles in use. Every time a motor vehicle is driven from the salesroom there is an-

other driver added to the already large number that are now using the steets. Oftentimes that driver is given just enough instructions to enable him to get that machine out of there and get it home, with no instructions as to the traffic rules or the mechanism of his car.

In Los Angeles the motor bus business developed almost over night. On the first of October we had no motor busses, and on the thirtieth of October we were issuing forty to sixty licenses a day to men to begin the motor bus business; in the parlance of the street, the "jitney" business. We had over 1,800 in operation the first of January. The most of those vehicles were owned by men or purchased by men who made a payment down on them, knew nothing whatever of the traffic laws, and put themselves up as drivers in our heavy traffic in the downtown district. The consequence was that within ninety days from the beginning of the motor bus business until it reached its height, the number of accidents increased in Los Angeles 35 per cent. It was very appalling, and it was a very serious problem.

We began an agitation for an ordinance that would place some restriction on these men to regulate them, as to who should drive, and things of that kind. Among other things, we got an ordinance through that provided that every man must take an examination. That examination is held under the supervision of my department, and the first week of that examination, beginning in July, we examined 300 of those drivers. Out of that three hundred there were some seventy-five that fell below seventy-five per cent. Seventy-five of the men that had been driving two or three years couldn't answer forty per cent of the questions regarding traffic. We turned those men down and told them they could take the examination again within two weeks, and for them to come back and see if they could do better. Oftentimes they came back and passed 80 or 90 per cent of those questions, showing that if they have to they can pass it. We make them give a test of their ability to drive among the heavy traffic, and drive in narrow roads, and things of that kind, to demonstrate that they do understand the handling of their machines. I believe it is only a question of time until that method will have to be adopted as regards the drivers. When machines were few the possibility of accidents was not so great. Since machines have increased so rapidly on our highways, the possibility of accidents has increased proportionately, and I believe it is coming to that.

There is one thing that every man in this convention should bear in mind, and that is the grade crossing. I am heartily in favor of the president's statement there that the grade crossings must be eliminated. Some one made the assertion that one of my neighbors next door was killed when

he had a clear vision of the crossing, a half mile in each direction. Another man was killed at Santa Anna, where he had a clear vision of the track for a half mile in each direction. That is carelessness. It is carelessness in 90 per cent of the accidents and I strongly advocate examination as a step towards eliminating accidents and adjusting the traffic conditions. (Applause.)

CHAIRMAN WILSON: A number of years ago Shakespeare wrote, "That is a consummation devoutly to be wished." We tried that in New York state, the examination of drivers and the issuing of certificates, and we had to abandon them. It was an impossibility. To have an examination, you have got to have an examiner in each town, but that is for the states themselves. That is not a national question. We have got two or three things on our regular programme to which we will now return.

MR. MEHREN: Mr. Chairman, in reference to the matter of "safety first," I believe that all of us could contribute somewhat to the movement if we gave more serious consideration to our civic responsibility. Let me explain what I mean. To begin with I think it is absolutely nonsensical to inveigh the automobile drivers and to attribute all automobile accidents to them. Nevertheless, there must be a considerable number, a large number, of accidents due to reckless driving. How many of us, however, are willing to make the necessary sacrifice of time to bring a reckless driver into the clutches of the law?

Now, let me tell a story. It will take only a minute. Just a short time ago a child was killed on account of reckless driving, within a half mile of where I live. That night a neighbor living next door to the place where the child lived was in my home. He said to me, "Did you hear about the death of Frank Smith's boy?" I said, "Yes, too bad, isn't it?" He hesitated a minute and said, "Yes, it is too bad, but what are you going to do about it?" Well, I had no idea what he meant by the question, what I was going to do about the death of that child, through reckless driving. Then he explained his point. I have four boys. He said, "Suppose your oldest boy had been killed today by reckless driving, what would you do about it?" I couln't help but feel my blood boil and feel I would like to get my clutches upon the reckless driver that had been responsible for that child's death. I have made a resolution, gentlemen, that if I can get witnesses I shall bring to the attention of the officers of the law every reckless driver that I see on the city streets. I am going to make that much of a sacrifice for the safety, not only of my child, who might have been killed, but all other children who are endangered by reckless driving. (Applause.)

CHAIRMAN WILSON: The paper that was to have been read this afternoon by A. H. Blanchard, professor of Highway Engineering, Columbia University, on "Equipment for Highway Work," will be read by a title and permission given to print.

Equipment for Highway Work

By ARTHUR H. BLANCHARD
Professor of Highway Engineering, Columbia University

Fundamentally, the problem of the selection of economical and efficient plant equipment is the same for the highway departments of states, counties, and municipalities and contracting companies. The selection of equipment for the construction and maintenance of highways should be based upon a consideration of the following factors: (1) Character of work; (2) specification requirements covering plant equipment; (3) amount of work; (4) portability of plant; (5) large and small units; (6) ease of manipulation; (7) adaptability to different classes of work; (8) funds available; (9) depreciation of plant; (10) transportation facilities. The practical necessity for the consideration of many of the above factors is self-evident.

Character of Work.—In the case of contractors whose work is confined to the construction of sheet asphalt pavements and in the case of a department such as, for instance, that of Wayne County, Michigan, where the highway work consists primarily of grading operations and the construction of cement concrete pavements, the problem is materially simplified. On the other hand where a contractor's work covers the construction of all the various types of roads and pavements used in a municipality, county or state, the selection of the several units of plant equipment should be based upon their adaptability to different classes of work. For example, where cement concrete pavements as well as concrete foundations are to be constructed, in many cases a type of mixer should be purchased which is satisfactory for the construction of pavements, the requirements for which are more specific than in the case of mixers used only on foundation work.

Specification Requirements Covering Plant Equipment.—In the modern practice of highway engineering, many specifications include specific stipulations which must be met by machines and accessories employed. As illustrations might be cited the weight of rollers, pressure limitations in distributors, grouting apparatus, and details of mixers for the manufacture of bituminous concrete.

Amount of Work, Portability of Plant, Large and Small Units.—It is evident that a contractor or a department will be justified in the purchase of an ideal equipment if the work

is to be extensive in character. If the work is centralized and large in amount, as in the case of sheet asphalt work, in many municipalities a large, well-equipped permanent plant will prove economical. If, on the other hand, the work is large in amount but distributed over considerable area, small portable units will prove more satisfactory, as in the case of mixing plants for the manufacture of bituminous concrete to be laid on state and county highways.

Ease of Manipulation.—In cases where contractors are engaged in general highway work and their organization does not include foremen who are specialists in the manipulation of various types of complicated machinery, it is of utmost importance that simplicity of machines and ease of manipulation should be given great weight in the selection of equipment. This is particularly true in connection with various types of machines used in the construction of bituminous surfaces, bituminous macadam and bituminous concrete pavements.

Adaptability to Different Classes of Work.—It is well known that specifications for different classes of work, requiring the same type of machine, call for differences in detail. For grading work, specifications might require rollers weighing from 12 to 15 tons, while in the construction of wearing courses of some types of pavements a 10 to 12-ton roller is stipulated. A contractor who is handling a small amount of general highway work would, therefore, find it advantageous to purchase a 12-ton roller suitable for both classes of work mentioned above.

Funds Available.—Departments and contractors are necessarily forced to consider first cost of equipment, as the funds available may not permit the installation of the most economical and efficient machines. In many cases where such conditions are encountered, it is obvious that it will not be practicable to anticipate that the work can be accomplished with the same degree of rapidity and at the same cost as if more efficient machinery constituted the plant equipment.

Depreciation of Plant Equipment.—Depreciation charges on plant equipment should be given careful consideration prior to the purchase of machines and accessories as well as in the consideration of the cost of highway work.

Transportation Facilities.—Facilities for the transportation of machinery and materials materially affect the efficiency of the several units of plant equipment. For example, in municipalities, counties and states where materials may be transported over highways in good condition, the use of the motor truck will usually be found desirable.

Brief consideration will be given to the plant equipment suitable for grading, quarrying, construction of the several types of roads and pavements, street cleaning and snow

removal. The limitations of this paper will prevent the consideration of small tools and accessories. It is also evident that normal conditions usually will be assumed as the basis for sugestion of plant equipment for the various items of highway work enumerated above. Wagons or motor trucks will be found a necessary part of equipment for all classes of work.

Grading.—Grading operations vary from the scarifying of an old road surface, preparatory to the construction of a new wearing course, to heavy cut and fill work requiring the moving of thousands of cubic yards of material. It is apparent that only extreme conditions can be mentioned in this discussion as the economics of the utilization of various classes of machines on average grading work would necessitate a comprehensive discussion. For the lightest class of grading mentioned, scarifiers drawn by rollers have proved more economical and efficient than the use of picks in roller wheels or any one of the several types of plows drawn by rollers or tractors. For the heaviest class of grading work, in many instances steam shovels loading into wagons will be found economical. In connection with all grading work except light scarifying, one or more of the following types of machines should form a part of the plant equipment for grading: Road drags, grading and rooter plows, drag and wheel scrapers, elevating graders, and rollers. It should be noted that the utilization of the elevating grader has not been fully developed by many contractors. It should also be noted that many engineers and contractors prefer the construction of embankments in thin layers with light, smooth-faced rollers or sectional rollers instead of the construction of the maximum thickness of layers allowed by specifications and compaction with 15 to 18-ton rollers.

Quarrying.—Plant equipment for quarrying depends primarily upon the kind of rock, the required output per day, and the length of time during which the quarry will be worked. Drills and blasting devices are a necessary part of all equipment for rock work. Contractors or departments working the quarry to supply material for a specific highway would use the ordinary portable crushing and screening plant consisting of boiler, engine, jaw crusher, elevator, screen and bins. Small quarries, more or less continuously operated, are generally equipped with the above plant except that in many cases the gyratory crusher proves more economical. Passing to the largest quarries, modern equipment for the economical manufacture of broken stone should consist of steam shovels for removing the rock masses from the quarry face to steel cars. In such quarries the pieces of rock transported to the crusher may vary in size up to masses weighing 7 or 8 tons. The rock should be first

crushed in a mammoth jaw crusher from which the rock should be passed through a series of gyratory crushers, jaw crushers and rolling mills and thence to elevators, screens and bins. In some plants of this type washing devices are a necessary part of the equipment in order to produce stone chips free from dust.

Earth Roads.—In the construction of earth roads on a large scale, the following equipment has been found to be economically efficient: Elevating grader drawn by horses or by a tractor, scrapers, disc and straight-tooth harrows, road drags, rollers and watering carts. The combinations of the machines mentioned which will be used will depend upon the amount of work, character of the soil and the cross section to which the road is to be built.

Gravel Roads.—Spike-tooth harrows, scrapers, road drags, rollers and watering carts constitute the equipment for the construction of gravel roads. Many engineers and contractors have found grooved rollers more satisfactory for this class of work than smooth-faced rollers.

Broken Stone Roads.—The average equipment consists of harrows, rollers, and watering carts. For many types of construction and kinds of rock, rolling for long periods with 10 or 12-ton rollers has secured a better compaction and economical bond than in cases where 15 and 18-ton rollers have been used for short periods. Some contractors have found automatic screening spreaders a valuable addition to the plant equipment.

Bituminous Surfaces.—The equipment required for the construction of bituminous surfaces depends upon the amount and character of the work and the rapidity with which it must be accomplished. For example, the construction of a bituminous surface on a broken stone road will require an equipment of rotary brushes or coarse fiber brooms, bass fiber brooms, in some cases batteries of heating kettles, a distributor to meet specifications and adaptable for the distribution of the kind of bituminous material under conditions stipulated in the specifications, pouring cans, squeegees, and, in some cases, 5 to 10-ton rollers and hand-drawn or horse-drawn automatic stone chip distributors.

Bituminous Macadam Pavements.—The equipment will depend primarily upon the specifications and the kind of bituminous material employed. The usual equipment consists of batteries of heating kettles, a distributor, pouring cans, and a roller. The specifications covering certain features of the distributor may be specific, as in the case of the 1914 specifications adopted by the American Society of Municipal Improvements herewith quoted:

> The pressure distributor employed shall be so designed and operated as to distribute the bituminous materials specified

uniformly under a pressure of not less than twenty (20) pounds nor more than seventy-five (75) pounds per square inch in the amount and between the limits of temperature specified. It shall be supplied with an accurate stationary thermometer in the tank containing the bituminous material and with an accurate pressure gauge so located as to be easily observed by the engineer while walking beside the distributor. It shall be so operated that, at the termination of each run, the bituminous material will be at once shut off. It shall be so designed that the normal width of application shall be not less than six (6) feet and so that it will be possible on either side of the machine to apply widths of not more than two (2) feet. The distributor shall be provided with wheels having tires each of which shall not be less than eighteen (18) inches in width, the allowed maximum pressure per square inch of tire being dependent upon the following relationship between the aforesaid pressure and the diameter of the wheel: For a two (2) foot diameter wheel, two hundred and fifty (250) pounds shall be the maximum pressure per linear inch of width of tire per wheel, an additional pressure of twenty (20) pounds per inch being allowed for each additional three (3) inches in diameter.

Bituminous Concrete Pavements.—The type of pavement, amount of work, the specifications and the kind of bituminous material employed materially affect the selection of the plant equipment for this class of work. Batteries of heating kettles and a roller are required for the construction of all types of bituminous concretes. Although the practice of contractors has varied to a considerable extent with reference to the weight and type of roller, many now favor the 10 to 12-ton tandem roller for all classes with the exception of Topeka bituminous concrete. The practice has also materially varied with reference to the type of mixer employed. It has been demonstrated, however, that for all classes of bituminous concrete work, a contractor, who is to construct a considerable yardage of this type of pavement, should have a mixing plant which includes the following units: Heating kettles, elevators, a drier, bins, weighing devices and a pug mill mixer. For pavements of the type of bitulithic, a rotary screen is a necessary adjunct to the plant. For those types of bituminous concrete in connection with which seal coats are employed, the equipment will necessarily be increased by the addition of hand-drawn distributors, pouring cans, squeegees, and, in many cases, hand-drawn automatic stone chip distributors.

Sheet Asphalt Pavements.—The plant equipment necessarily depends upon the amount and location of the work and the specifications. A tandem roller constitutes a part of the equipment for all sheet asphalt work. The mixing plants are of three types—portable, semi-portable, and permanent. A complete plant includes a cold sand elevator, a

drier, a hot sand elevator, a hot sand storage bin with screen, an asphalt elevator, a flux tank, melting tank, draw-off tank, a sand measuring box, a dust elevator, bin and measuring box, an asphalt cement bucket and a pug mill mixer.

Cement Concrete Pavements.—Variations in economical equipment depend primarily upon the specifications. A beam and bucket cement concrete mixer, forms, templates, bridges, watering carts, pumps and hose usually constitute the equipment for the construction of cement concrete pavements constructed by the mixing method.

Wood Block Pavements.—For the building of wood block pavements, the equipment should include the necessary apparatus for the construction of the mortar cushion or a template and hand roller when a sand cushion is employed, a tandem roller weighing from 3 to 5 tons and the necessary distributing apparatus for the application of fillers and the construction of expansion joints.

Brick Pavements.—The equipment should include a wood template and hand roller for the construction of the sand cushion, a tandem roller weighing from 3 to 5 tons, brushes, cement grout boxes if a cement grout filler is employed or conical pouring cans if bituminous fillers are used for the construction of transverse or longitudinal joints.

Stone Block Pavements.—The equipment includes, in some cases, templates and hand rollers for the construction of the sand cushion, tampers and the necessary apparatus for filling the joints.

Street Cleaning.—The equipment required for street cleaning will be influenced by the types and yardages of roads and pavements. Earth, gravel and broken stone roadways require push brooms or horse-drawn or motor-driven rotary sweepers and watering carts. Bituminous surfaces and good brick, bituminous and wood block pavements necessitate an equipment for hose flushing and squeegeeing or rotary squeegees and watering carts. Brick, in poor condition, and stone block pavements call for an equipment of hand brooms, rotary brushes, hose for flushing or flushing machines.

Snow Removal.—Equipment for snow removal is affected by the amount of snow in a storm, the yardage and location of the roads or streets to be cleared. For municipal work road scrapers and horse-drawn and motor plows have been found economical and efficient. In some cases apparatus for flushing, either hose or power flushing machines have been found advantageous. In the case of many roads, compaction of the snow being principally required, snow rollers constitute the equipment.

Equipment for Maintenance.—In a brief paper it is not practicable to discuss the equipment for maintenance for all the various kinds of roads and pavements. The type of road

or pavement, the yardage of each type of highway within a given district and the organization of a highway department or the specifications under which contractors must maintain highways necessarily materially affect the selection of an economical and efficient plant equipment.

As an illustration will be cited plant equipment which would prove satisfactory for the maintenance of 50 miles of bituminous macadam and bituminous concrete pavements in a given district. The equipment should include a motor truck and a trailer. The truck would be used for transportation of broken stone, sand, cement, fuel, bituminous materials and, in some cases, small tools and accessories. A trailer should be permanently equipped with a small mixer, drier, and melting kettles. In many cases the following accessories can be used efficiently: A hand-drawn gravity distributor, pouring cans which distribute the material in the form of a sheet, conical pouring cans such as are used for the application of bituminous fillers, coarse fiber and bass fiber brooms, a heavy hand-drawn roller, tampers, smoothing irons, squeegees, a large hand power bellows, a small surface heater, and other small tools such as shovels and picks. If large areas are to be repaired, a horse-drawn sweeper, a small pressure distributor and a tandem roller should be included in the equipment.

CHAIRMAN WILSON: The time is drawing near now, if you want to see the pictures and hear our friend from the north. I am certain this will be an opportunity for you, and repay you for your time. I am obliged to you for the attention you have given me this afternoon, but it is the same thing over again. You have these questions that should be brought up at the different state legislatures. First get your own people and convert them. Then we will have uniform laws. We have been fighting for them for the last ten years, but the gentleman from Connecticut wants it one way, the gentleman from New York wants it another, the gentleman from New Jersey wants it another. The speed limits are different in the various states, and the result of it is that where you give an automobile driver a straight road, the chances are that he is going just as fast as his wheels will turn around. And I want every one of you when you have a man pass you at a speed that puts you in danger, to make an information against him and make him pay or make him quit driving. Now Brother Hill is from the north, and he is from the whole United States. He represents the United States. Now he is going to tell you about something he has accomplished, and has been accomplishing in other places.

SAMUEL HILL: Ladies and Gentlemen: I want to show you this afternoon some pictures of the roads of the

world. Before I do that, however, I will show some pictures by E. H. Curtis, who has given thirty-three years of his life writing for the North American Indian. He lived with all the Indians throughout the country, taking the part of a priest in a snake dance down in Arizona. I know these pictures will be very fine, because Mr. Curtis never does anything that isn't fine. Unfortunately, his pictures are not shown here in the Washington building on the grounds. I hate to say anything against my own state, that of Washington, but I was very much disappointed not to find these pictures over there, and not to find a picture of the building, the building of all the state of Washington that was marked "Good Roads;" the first building ever erected in the history of the world that was marked "Good Roads." Major Bowlby is handling the stereopticon for me, the man who built a part of the Columbian Road, and the road to the Siskyou Pass. You will see pictures of both of those roads. I won't talk much while the pictures are being shown, but I may add a few words as they appear on the screen.

(At the conclusion of the setreopticon pictures, the meeting adjourned until Friday morning, September 17, 1915, ten o'clock.)

THURSDAY EVENING LAWN FETE AND DANCE

An illuminated lawn fete and dance was tendered the delegates to the Pan-American Road Congress Thursday evening by Mrs. Adolph B. Spreckels, one of the vice-presidents of the Pacific Highway Association, at 2042 Vallejo street, San Francisco. During the evening there were music, dancing and speeches. Among the speakers were Samuel Hill, president of the Pacific Highway Association; James H. MacDonald, former State Highway Commissioner of Connecticut; Major W. W. Crosby, former chief state highway engineer of Maryland, and others.

EIGHTH SESSION

Friday, September 17, 10:00 A. M.

JAMES H. MAC DONALD: I rather expected we might possibly have a slim attendance this morning, as there are so many counter attractions and so many of our delegates who desire to get home over the Sabbath, and for various reasons we have not a large attendance. I had thought that perhaps this might be made an hour for the review of lessons that occurred to those of you delegates who are present, through the papers and discussions that we have had through the week, while we are waiting for those who are to participate in the exercises this morning to appear. So I have great pleasure in introducing a gentleman that I think of all commissioners in the United States occupies a sort of unique position in himself. He has been without any doubt to more conventions, both on this side of the water and the other, and good roads meetings, than any man I know of in the country. We are singularly fortunate in bringing Colonel Sohier from Massachusetts, with all they have to do there, to preside over our meeting. I take great pleasure, Gentlemen, in introducing Commissioner Sohier, who is the chairman of the Massachusetts Highway Commission. (Applause.)

(Col. W. D. Sohier then took the Chair.)

CHAIRMAN SOHIER: I find that Mr. White is not here. He was to deliver a paper on "Comparisons of Traffic and Their Economic Value." I think from the fact that he is not here it is probably because he didn't known too much about the subject. Therefore I though I would tell you a little about it myself. We have one thing in common with the West, and that is, cheek. We are not afraid to talk about things we know very little about, because we feel you know less. It is a great place, really. By the way, If Mr. Connell is here I should like very much to have him come up on the platform.

I don't quite understand what is meant by the economic value of the traffic; whether it is the economic value of the road for the traffic or the cost of the traffic on the road in repair. Personally I know very little about the economic value of the traffic, except this: that in round numbers it is costing us in this country 25 cents a ton a mile to haul our goods and to haul our road materials and to haul our farm products. It is costing in France 7 to 8 cents a ton a mile, and one of the engineers in England who had in his county thirteen steam rollers and tractors, in that one county, told me that he had gotten his road material down now to 5 cents a ton a mile, provided he had more than a mile of haul, and was hauling it by a traction engine with two trailers, carrying 6 tons on the engine and 8 tons on the two

trailers. Now in Massachusetts we allow practically 25 cents a mile for hauling the first mile. We are getting it done under contract for considerably less than that; but the economic value of the traffic, or rather the economic value of road really depends on what that road has got to perform as a duty to the public. I think at some time in the very near future we shall have to adopt restrictions on our traffic on the kind, class and character of traffic, in order that the money we are spending on our roads shall not be taken away from us by some one or two or three persons who desire to make money out of the road, and make too much money, more than their fair share.

We are continually hearing talk from the automobilists that they ought not to pay a license tax if they also pay a property tax. Now as a matter of fact the automobilists I think nowhere pay anything like what they are costing in the increased cost of both construction and maintenance of roads except on paved streets. What is true of the automobile is even more true of the truck. In Massachusetts we have adopted substantially the French and English rule in regard to the weight of the traffic. We have limited it to fourteen tons, including vehicle and load. We have limited it to 800 pounds per inch width of tire, or whatever rests on the road surface, no matter what you are moving over the road, and we have provided that no wheel or other object moving over the road shall have any attachment that will substantially cut into or injure the road surface. We have further provided that when anybody does injure the road by using what he is not entitled to use by law, that the road authorities can recover for the actual damage that he caused.

Traffic is a very hard thing to determine, because no matter in what way you try to determine it, you have got to select some period, as it is not worth the cost to count all the time. In Massachusetts we have been selecting three-year periods, and it so happens that this year is our third triennial. You find, or we find something that we really don't understand. We are trying to build our roads so that they will be sufficient to take the traffic that the people can carry over them, but we are unfortunately finding that as we improve the road the motor vehicle improves faster. The motor vehicle improves faster than we improve the road, and we really can't keep up or keep ahead. We have now got some machines in Massachusetts that are carrying eighteen tons, and somebody asked us the other day for a permit to move eighteen tons on one road over the bridges. By law in our state the town authorities or the county authorities who have charge of the bridges can post a bridge so that it can't have any more than three tons over it except at the risk of the owner. We wrote back to him that we not only wouldn't grant a permit, but we wished to notify him that

the bridges over which he was going to travel were not sufficient to carry eighteen tons. Formerly all of our state highway bridges in Massachusetts were designed really to carry fifteen tons with a factor of safety of four, so he wouldn't hurt those probably, but he would break the little country bridges. We now design them to carry twenty tons, with a factor of safety of four.

It has never seemed to me that it was right for any one member of the community, no matter if he can make some money for himself or save a little money, to destroy the property that belongs to the other taxpayers. Now one truck in a lumber district in a little town in Massachusetts went along with about twelve tons and it destroyed four bridges. It meant three dollars on the tax rate in that town next year to repair those bridges in that town, and he was just one citizen of the town. Now that does not seem fair. Under the law at that time if they had posted the bridges the town would not have been liable for damages, but the town couldn't recover from that man and if he had had to pay the damage he had caused, rebuild the culverts, it would not have been economical for him to use the trucks.

You will find in the reports of the International Road Congress, and the reports of the Road Board in England, a great deal of interesting information on the subject of traffic, and the cost of the upkeep of the roads, compared to the traffic that goes over them. You will find some quite interesting figures. The difficulty with figures is if you don't compare them with some other figures, they don't really mean anything. You will find that it costs to keep a road up, a macadam road in England, for instance, all the way from a quarter of a cent a ton a mile to a cent and a quarter a ton a mile. You will find if you figure that cost and the interest on the cost of a more expensive type of pavement, that somewhere around a half of a cent a ton a mile is a dividing line between where it is economical to use macadam and keep it in repair as they do in England—and we do not generally in this country keep it constantly in repair—somewhere around a third of a cent a ton mile; and it is cheaper to build a stronger form of pavement, paying according to the traffic all the way from—I am using our figures in Massachusetts—all the way from a dollar and a half per square yard for concrete, or a dollar eighty-five for concrete with asphalt top, say, to three dollars or three dollars and a half for granite block on a concrete base. In other words, if the cost of upkeep is much over ten to twelve and one-half cents a square yard a year, you can better afford to pay the interest and sinking fund during the life of the road on a more expensive form of pavement, and at the end of twenty years you will find that you have spent less money than you would have spent if you had paid say

20 cents a square yard a year for maintenance instead of twelve and one-half cents. That is about where it comes with us.

All of you gentlemen in your various states will have to figure what it costs you, if you have got a certain class and character of traffic. For instance, I just received a telegram which illustrates how little one really knows about roads. We built a little road over Hoosic mountain, in Massachusetts, called the Mohawk Trail. It is on the main line east and west. I suppose the average three or four years ago was possibly twenty cars a day and seven or eight or ten teams, and anybody that went over that road who didn't have to never went back. I had to because we were improving the road, and when we had improved that road we got a seven and one-quarter per cent. grade in place of an eighteen per cent. grade; and you didn't climb over any boulders that were more than a foot high. (Laughter.) But you take an eighteen per cent. grade and boulders a foot high, and no matter what your car is, it is better to have a steam car. We usually had a steam car on that trip. You don't repeat the experience, especially if it is wet, unless you have to.

Now last year we opened up about sixteen miles of this new road. It is nothing but a graded dirt road, and it runs through some beautiful scenery and forms an important link in the main through road in the northern part of the state. It certainly did not have twenty-five vehicles a day. You would hardly know what you were to anticipate over a road of that kind; but I just received a telegram from my Division Engineer, who was not satisfied with his traffic account in August, because he got a wet Sunday, and we find Sundays are about 33 per cent. of the week, and that on Sunday, September 5, from 7 A. M. to 7 P. M. he had 3,268 automobiles go over that road, where less than 50 went over, vehicles of all kinds, three years ago. Now we expected to maintain that road as a graded dirt road. We have got a section gang every six miles. We are dragging it always after the rain, and always once a week, and we have to use a light oil on it. But if it happens to be a rainy day and we get a thousand cars over that in a day you are bound to rut any dirt road so far as I know. At any rate any of the dirt in that road will get rutty. On one end of that road we have got a sort of hardpan which is almost the equivalent of gravel, and that is very good except it is a little slippery, and we have to sand it. That illustrates, I think, the amount of care that a man has got to take in designing his road. He does not realize, and it takes him a long while to realize, what his traffic figures mean when he has them. Seeing that Mr. White was going to talk about traffic, I though last night

I would take some of my traffic sheets of this year and try to see what they meant; try to see if I could say anything that would be of value, although we don't regard our traffic account as complete until we have got a week in October as well as in August. I found there was not a great deal that I could select out of the figures.

There were, however, one or two things which might be helpful to some of you. The roads in and around Boston and the big cities have all shown an increase in traffic this year over three years ago, and three years before that; that is, just about in proportion to the number of automobiles registered. In other words, we have got a hundred thousand cars registered now, and we had three years ago something under sixty thousand, we had six years ago something about thirty thousand, and the traffic has increased substantially in proportion to the number of cars that have been registered; and the same thing has been true of other states.

Massachusetts has the good fortune to be a sort of a playground, as California is, and so all our neighboring states come into our state in summer, and we think that about one-third of all our traffic, so far as we can find, is out of state cars. We found one or two things that really do make a difference in what you have got to do on your roads. In and around the large cities the traffic, while it had increased substantially 50 per cent. since three years ago, had increased almost entirely in motor vehicles on pneumatic tires, and please note the pneumatic tires. A pneumatic tire is never giving a stress on the road of more than 80 pounds or 85 pounds at the most per square inch. Now if you will figure that out you will find that it does not put any real weight on the road, because they have five or six or seven square inches in contact with the road at all times, so that they don't crush your road. We found that we could easily take care of any number within reason. At any rate we could easily take care of more than five hundred motor cars a day on pneumatic tires, on a gravel road with a coat of light oil, or possibly two coats the first year, and constant patching. We cannot take care of 100 motor cars a day without the oil, no matter if we shape it once a week. It is too expensive and the road is never in good condition. We have one road twenty-six miles long of gravel. Six years ago it carried thirty-seven cars a day, three years ago two hundred and fifty, and this year it has over a thousand automobiles a day. Now three years ago we were taking care of two hundred and fifty motor cars, and mind you that road is up and down hill in the country, and is really an automobile speedway, but it does not have much team traffic. Three years ago we took care of that with a section gang every eight miles, shaped it up once a week, anyway, with a road

machine, and after every rain, and until you got near one of the larger cities, like Lynn, you had a very good road. It was rather rutted on Monday morning, because fifty per cent. of the traffic on that road, as on all of our through roads, is Saturday and Sunday. Over fifty per cent. of the whole week, and Sunday is usually thirty-three per cent. of the week. We have used the light oil on part of that road, but last year we couldn't. This year when we got up to a thousand cars a day we could not keep that road by the shaping method so that it was in fit condition to travel over. It was rutted at least six inches deep every Monday morning. If any of you have ever tried to drag out a rut six inches deep you know it is very hard. The gravel is thrown out by the cars. You can only drag in loose gravel.

Now we are maintaining it for less money with oil and constant patching. The moment you use two quarter gallon coats of oil the problem of maintenance changes from the problem of dragging and shaping the road every Monday morning, to the problem of patching the oil road, and that we are doing by two methods. If it is more than a surface abrasion of the oil, if it is an inch deep, say, a little chuckhole, we are filling it with a mixture of oil and gravel, using stone up to three-quarters the depth of the hole. If it is merely that the oil is gone off the surface, we give it a paint coat of oil and throw some gravel on that, and let the man come back at the end of the day and uncover.

MR. ROY: What grade of oil do you use for that?

CHAIRMAN SOHIER: We use on that about a forty-five per cent. oil the first time, to get a penetration. We found if we used a sixty-five, which we like to use and do use, by the way, on macadam roads, it depends entirely on how hard your road is. If on the rough roads we used sixty-five per cent., the heaviest oil you can put on cold, we found it broke up and went into chuckholes much faster than the light oil did; and putting on two coats of light oil this season, or after we have got the road in shape, the next year it usually takes about two coats of one-fifth or one-quarter gallon of the lighter oil; in fact, you could use hot oil if you wanted to, after your road is once thoroughly oiled, shaped and compacted. We have done that with pretty good results in some places. On the light material we tried some of the Texas oil, about sixty-five per cent. oil, and it was not any good at all, and we had to go back to a much lighter oil, in order to get as good results on gravel or dirt which was more or less loose. In other words, the lighter oil will help you to pack the material, and in the end you get a crust of perhaps two or three inches. I am not saying that you can do that on dirt, but I think you can do it on reasonably sandy and gravelly roads if you haven't got much team traf-

fic. By the way, I shall be glad if anybody will ask me anything at any time. I didn't have anything to say this morning and that is the reason I am talking so much. (Laughter.)

Now one thing that has made a difference, as I started to say a minute ago, in what we have got to do in the future; the one lesson I was reading out of that traffic paper was this: I don't see anything that is making much difference in what you have got to do to your road at various places, except this: The single horse light vehicle has departed from most of our roads. The single horse heavy vehicle has diminished something like 50 per cent. in six years, and 25 per cent. in the last three years. The double horse light vehicle really doesn't exist. Road after road where there used to be 25 or 30 two-horse light vehicles, now have none. The two-horse heavy vehicle has on the whole decreased about 15 to 25 per cent., and around the cities the weight of traffic has not increased materially. I am now speaking of the traffic roads around the city, although that double horse vehicle has been replaced by the motor truck. A road that had an average of seventeen motor trucks a day three years ago now has seventy-five to a hundred. I don't think that really makes much difference on the roads that had a hundred two-horse heavy vehicles, for the reason that you cannot maintain a road to carry two hundred three-ton loads with iron tires, without building it at least as good as a macadam road. You can't maintain it economically. I think you would find if you tried to maintain a dirt road for near two hundred three-ton loads a day, it would never be in good order; it would always be rutted, and it would always have holes. You might shape it every single morning, but if it has got to carry 3,000 tons a day it is going to wear out at once. We had an experience, by the way, when Mr. Frick built a house in Beverly. He had a very handsome place, and among other items he had 200,000 yards of filling, and he had a hundred thousand yards of loam, and by the way for the fiilling he paid $1 a yard and for the loam $2 a yard. That has nothing whatever to do with what he hauled over the road to build stone fences; iron bars, to build his home and build his stables and build all the other things; but actually there was 300,000 yards of material hauled over a new macadam road and it wore down over two inches in one season. I don't know whether Mr. Frick is the only man in the country that looked at it from the point of view that I was looking at it a moment ago, that one member of the community has not got the right to charge the other members more than his fair share towards what he was doing, but Mr. Frick said, "practically I have ruined the road from the siding down to my house. Now I would like

you to put that road back in as good order or better than it was before, and send the bill to me and I will pay it." He did pay the bill. So that year, when it was two years old, we rebuilt the road and it needed over two inches of stone to do that. It took about 22 to 25 tons to the hundred feet of road.

What I was saying a minute ago on the city roads, mind you the traffic had increased tremendously, don't understand it hadn't,—increased 50 per cent.,—but the weight in traffic in either iron tires or trucks had not very materially increased, not more than ten per cent.; whereas the automobiles on pneumatic tires increased 50 per cent., which shows that in trying to find out the value of the traffic, for the purpose of deciding what class of road you are going to build, you want to know exactly the class of traffic. You can't do it by calling it so many automobiles of so many tons. As I said a minute ago, we can take care of five hundred automobiles a day on a graveled road, oil top, if we don't have the teams. The next thing I found in the figures is this, and this is really a significant thing to you gentlemen who are building through the country. Our purpose is to build a through country road, and help the little towns to build their roads. We are to build 165 miles of road in some 45 towns in Massachusetts in the next three years, where the legislature made a special appropriation of two million and a half dollars, and most of that has got to be a country road. But in building that country road, we have got to consider what is going on it after it is built; whether it is going to be in the class of the road that increased from 35 cars a day to 500 cars. What was really significant in the figures is this: We have a good many cities of from 50,000 to 100,000 inhabitants that are situated within about 36 miles from Boston. There are twelve cities for instance of about 100,000, and all situated within about fifty miles of Boston; and on some of the lines there are two or three cities within that same distance, going out north, for example, but on all of those through routes, you will find that where three years ago you got seven, ten or fifteen trucks, that this year you are getting 75 to 100. And on every through road, many of which had no motor trucks whatever three years ago, you are now getting 35 to 50 a day. All up and down the Connecticut valley the delivery of all the fruit and a good deal of meat is being made by motor truck, and that is an experience I thing you are all going to get. All of our large stores in Boston, our furniture stores, our dry goods stores, run regular routes of delivery once or twice a week, or sometimes every day, twenty miles and thirty miles and forty miles out of Boston and delliver without charge.

Now the reason of that is its economic value. As far as I

can find out it is not really that the truck can haul goods cheaper than the railroad; quite the contrary; but that having only one handling at each end, putting them in a truck where they wrap them up only in burlap instead of casing them for the railroad, and taking the burlaps back when they have delivered them in your home, they actually have cost less on account of the handling than it would have cost to send them on the railroad. Although, as far as I can find out, practically all of those trucks are costing from 20 to 30 cents a mile to operate, including depreciation. I would like to inquire if Mr. Connell has come in. I don't want to monopolize this morning. Has Mr. Stern come in? Gentlemen, there are very few of us present, and I feel that I don't want to do all the talking. We have asked Mr. Stern to come down.

Mr. Light says he would like me to read this resolution adopted at the annual meeting of the American Highway Association yesterday.

"Whereas the American Highway Association earnestly favors harmony and correlation of the organized good roads movement throughout the United States, it is ordered that a special committee of seven members be appointed by the chair and empowered to confer with similar committees from other organizations, and to consider and present to the association at a subsequent meeting or prior to such meeting at a meeting of the board of directors, suitable recommendations or changes in the constitution and by-laws and the working plan of the association as will best secure the desired results, as well as to bring into closer relations the efforts for road improvement in the eastern and western portions of the United States. The Chairman of the meeting will be the chairman of the committee." The six appointed were the following gentlemen: S. E. Bradt, Illinois, Chairman; W. R. Roy, Washington; A. B. Fletcher, California; W. D. Sohier, Massachusetts; T. H. MacDonald, Iowa; W. E. Atkinson, Louisiana; G. P. Coleman, Virginia; F. F. Rogers, Michigan. The meeting of the committee is called for one o'clock sharp today, September 17, Hotel Oakland, Room 101.

Gentlemen, there is an automobile trip tomorrow, which has been arranged for the delegates, and if any of you have not already told Mr. Pennybacker that you are going and have not gotten your name on the list, it will be necessary for you to register your name not later than 2 o'clock today in Room 200 Hotel Oakland. If you turn up tomorrow they will not have accommodations for you, but if you register today they will try to take everybody who wishes to go. It has been the purpose, I think, of the managers, that if we can get hold of Mr. Stern to get him to deliver his paper this morning, so that you could all have an opportunity this

afternoon to go to the fair. They have noticed, not unexpectedly perhaps, that there are so many attractions in San Francisco that a great many of the members go over there, instead of listening to the words of wisdom which they hear here. I don't want to say anything more, but I should be very glad to answer any question, or to have anybody discuss Mr. Linn White's paper on the Economic Value of Traffic and Traffic Accounts.

MR. WHITE: What kind of hard surface roads are you building?

CHAIRMAN SOHIER: Well, we are building, as I think everybody is, of the best material that we can obtain for reasonable cost, which will do the work. It depends entirely on what we believe is necessary for the traffic. We are building concrete with 1:1½:3 mix, and in some places that is as cheap a material as we can build our roads of. That is costing us about $1.40 a square yard.

MR. WHITNEY: Is that reinforced?

CHAIRMAN SOHIER: No. We did reinforce some, but it has all got contraction joints. The pavement is an average of 7 inches thick, to 8 in the middle and 6 on the side, and 18 feet wide. By the way, we found that where we had 18 feet we had quite a number of vehicles that went off the side. Where we built 19½ feet there hasn't been a single vehicle that went over the side. Whether that is a psychological fact or not, I do not know. I think you must remember that in Massachusetts we have anywhere from 12 inches to 5 feet of frost, and we have found that our concrete roads crack and become thrown, where we built them on a poor bottom. We built a concrete road about two miles and a half long, and we have measured it very carefully. It was 8 inches thick in the middle and 6 inches on the side, and cost about $1.40 a square yard. We thought we would copy Wayne country, Michigan, and we took a place where if we had been going to build a bituminous macadam we would have put a stone Telford foundation under it, or gravel, digging out the subsoil. We put a little drainage in. We put a foundation of gravel under some of that road, and wherever we did that the road is perfect. But it was a very wet country. It didn't do what in my judgment has been the real success of the Wayne county road. It did not heave evenly.

I was amused one time when Mr. Bartlett came down with the president of his company. I don't know whether you know Mr. Bartlett. If you have ever been around conventions at Detroit anywhere, you probably do. They happened to come in the office one day when I had just got our figures. I said, "Mr. Bartlett, you will be a little interested in these figures." You see a good many things out in Detroit that you won't see here, because we don't build our roads the way

you do. I told him I asked the county engineer out there how much his road was thrown by frost, and he told me that he had only had five cases where the road was thrown by frost; only five cases, I think. I had looked at the soil in Detroit where the water was up within six inches of the road, and I knew the temperature went down below zero, and I knew that we never built a macadam road in Massachusetts that was not thrown at least two to three inches by frost every year, and expanded, also came back again, and I couldn't believe him. I haven't the slightest doubt his roads were thrown every year three inches by frost, at any rate on the road I measured, and I showed Mr. Bartlett our road was everywhere thrown at least a minimum of two inches. Mind you that was a seven-inch road with 30 feet contraction joints. I am saying contraction, because they really are contraction, though the road will expand in hot weather after setting; but the real reason for making the joints is that the concrete contracts when it sets up. It doesn't expand. It contracts. By the way, it contracts more in setting than it ever expands again. Wherever that road was thrown two to three inches, and thrown evenly on both sides, it settled back again without cracking. There was no place on the road that was thrown less than two inches. Wherever that road was thrown two inches on one side and six inches on the other, there is a longitudinal crack, no matter whether it is reinforced or not. Two of our slabs didn't settle back evenly, and I think those five places in Wayne county where his slabs didn't settle back evenly, they considered the only places where the road had been thrown.

We have taken more pains in our foundation and drainage on our later roads, or shall take more pains on our concrete roads in the future; and we are hoping that the ones we build now are not going to get thrown enough to hurt them, because I think the difference between our experience and theirs was that our road was thrown very unequally. We had places where so much water came in that the road was thrown 10 inches on one side and only three on the other side of the slab. There had been no water there when the road was built. Where the road heaves two inches on one side and five and a half to ten inches on the other side, we have got a crack. We don't think they are serious. We fill them with tar and sand, or asphalt and sand, and while the patches look a little like a rag on a sore thumb, we expect to find that road a good one many years hence after I have gone off the commission.

J. T. HOWE (Houston Texas): You mentioned a little while ago that you had trouble with a certain kind of Texas oil. Have you abandoned the use of Texas oil?

CHAIRMAN SOHIER: No, Mr. Howe. We are using

Texas oil a great deal, as much as any other brand. We are using a great many brands of oil. What I said was this: We were using the lighter oils the first time on a road with loose gravel or dirt, and we found the Texas 65 flaked and scaled off quicker than the lighter Texas.

MR. HOWE: I have had that same trouble with the scaling with the Texas oil, and we have been unable to get results out of Texas oil on the gravel roads. I was wondering if you had exactly the same experience there and had given up the use of it.

CHAIRMAN SOHIER: I think on the whole that Texas oil, in fact several very good oils, are not really well adapted to a loose gravel road or dirt road if you use too heavy an oil the first time. If your road is well packed, the Texas is very good, and we have got a great many miles of Texas oil on old macadam base, where we have used Texas 45. And we have used Texas about 65 with pea-stone and sand, where the road is many years old. And everybody goes over it and says, what a beautiful road. As far as the automobile roads are concerned we get complimented more on these roads than any other road. On the old macadam roads over twenty years old, many of them have never had anything but a blanket coat of oil with pea-stone and sand rolled on top.

MR. ROY: In using that 45 per cent. oil, how much do you use on the first application?

CHAIRMAN SOHIER: We put on a quarter of a gallon to the square yard.

Is Mr. Perry Brown, city engineer of Oakland, or Mr. Connell present? Mr. Crosby says you and I can have a lovely time if we only stay here until twelve, as Mr. Brown and Mr. Connell are at the Hotel and will get here if they can. If they can't, Mr. Connell will submit his paper in writing so that there will not be any afternoon session. We would be very glad, if any gentleman here has got any remarks he would like to make, if he would get up and make them.

MR. REED: I feel we are learning now as it is, I don't think we can improve on what we are getting. I would like to know if you have had any experience with paint coats in the way of tars or asphalt on concrete?

CHAIRMAN SOHIER: Yes, Mr. Reed. We put down a pavement in 1906 on a through road. It was a six-inch Hassam pavement. The horses slipped when they got on the Hassam pavement. The Hassam pavement is a grouted concrete pavement. We have seen some good and some poor results with it in Massachusetts. That particular road is in perfect condition today, put down in 1906. In 1908 it began to develop some little pot holes about half an inch

deep. We decided that we weren't going to let that develop, so we tried to fill those places with sand and tar. We did. They stayed. Then in 1908 there was a half gallon of tar put over that whole road with pea-stone and sand rolled into it. It made a coating that was almost half an inch thick. That didn't require any patching for two years. It was patched in 1911 quite extensively, and it was given a quarter of a gallon in 1913. It has begun to need patching again. Before we gave it the quarter of a gallon coat, by the way, we patched every single hole there was in it, so it was an even quarter of a gallon, and it certainly has been a perfectly good road. I think that is the place where the value of the traffic has come in. That particular road is in Spencer, and I am not quite sure whether I have got that here or not. That tar surface is perfect. But let me say that we did the same thing in Long Meadow, which is just south of Springfield, and the tar went off inside of two months and was not any good at all. We are putting two inches of Warrenite on that road this year. Now the reason of that is just what I was talking about, or what Mr. Linn White was to talk about. In one week the total number of heavy single horse vehicles for Brookfield was 101. The total number of two horse heavy vehicles, 36, and the total number of automobiles was 4,000. The total number of motor trucks was 134. Now during that week in Long Meadow the total number of single horse heavy vehicles was 126, the total number of two horse heavy vehicles was 141 and there were over 550 light teams. I don't know whether you carry those, but it is 141 against 36. Now the total number of automobiles was 6,600 and the trucks 535. You see the reason that the tar worked in one place and didn't work in the other. In our judgment, at any rate, the reason is that there were so many horse-drawn vehicles that they cut down through the tar to the concrete, and there were not enough motor vehicles to roll it down, whereas in the other case there were not enough iron-tire vehicles to cut that tar. I just saw a gentleman from Ann Arbor, and I think they had exactly the same experience we had.

We just laid a concrete pavement at Somerville, right out of Boston, with heavy traffic, and we laid it some inches below the curb line with the idea that in two or three years we would probably have to put two inches of some form of bituminous material on top of that. By the way, I want to say we have been using oil since 1906 for blanket treatment. On all the main roads in Massachusetts you have got to use some kind of binder, because you have got over 100 cars a day in the summer season, and you usually have an average of 500 a day.

You will never make a success with oil or tar, in our

judgment, unless you thoroughly clean your road and compact it before you put it on, unless you patch your holes so that they will shed water when you get it on; because otherwise the oil will stay in that hole, and unless you keep it covered for a little while it will be picked up and carried off by the vehicles. I have seen a fresh coat of oil put on a road that had two coats of light oil before, and this was a coat of the heavy oil about the same as the California oil, and a team going along over that would pull up not only the oil, but pull up at least an inch of stone, with the old oil underneath, simply because somebody was bound to go over the fresh oil before we got a covering on it so that he couldn't pick it up. It was good oil and it stuck. That is the only test that I know of that is really good. A good oil ought to string out and not be short, and it ought to stick. You can use a little bit of dust-laying oil on a road, but you want to use mighty little. If you have got any oil that when you put it on your fingers you can rub off, it is not a good oil to use on a road. If you dig your pencil into it, and you have to cut the wood off the pencil before you take the asphalt off the wood, it is good. If you can rub it off on a sheet of note paper, it is not a good oil to use, and I don't think our chemical analyses are as good as that test. And yet we analyze everything and have for many years, but we are sometimes fooled by our analyses. There is something lacking. There is a breaking up, in my judgment, of the molecules of the hydrocarbon in the process of manufacture somewhere, and until you come down to analyzing the atom, I don't think you are going to come to know what you are using and whether it will succeed as well as you will by the simple old fashioned tests that they use, like the chewing test for tar; the fact that the tar and sand mix will crawl a long time; or, with the asphalts, that they string along before they break, and that you can't rub them off your finger. We forget that we formerly used a great deal of these paraffine road oils, and every one of those roads had gone into mush. It crawls and rolls and isn't a binder.

MR. COBB: What covering do you use?

CHAIRMAN SOHIER: I am going to answer that in two ways. If we possibly can we use peastone and sand, or pea gravel and sand. Where that is too expensive we use sand. If we are laying the dust and trying to prevent the oil picking up, why we even use dust. We sometimes use the dirt along the roadside. Where we have a fifteen-mile haul it would cost us a great deal to put the sand in. But we think the peastone and sand pays with any good grade of oil on the macadam roads, using about 50 per cent. of peastone and 50 per cent. of sand. Then we keep a man on

those roads for ten days, perhaps, keeping it covered; but a thousand cars a day will throw the covering off in the course of a day. We find it is much cheaper to patch our holes before they are holes, on our macadam road. We have a gang every six miles on the part of the road that we have been oiling, with a team carrying oil and covering with a couple of men, or three men, after a wet season, and we patch every hole. We patch all the holes on the road before they are holes, with a paint coat, and a little covering on top that is much cheaper than it is to wait until you get the holes and then fill them up.

MR. COBB: Do you patch with the same oil that you use in covering the road?

CHAIRMAN SOHIER: In the summer season we are using 65 per cent. oil for patching the holes more than an inch deep, using stone three-quarters of the depth of the hole. In the winter we are finding Headley oil works better than other oils. We are using some Headley oil. I didn't mean to mention that oil by name, because it is the same I think as several others, but that is a fluxed oil. It acts very much the same as an asphalt oil. My idea is that the asphalt oil is fluxed with lime or something like that.

MR. REED: What is your method of applying the oil?

CHAIRMAN SOHIER: We are applying the oil everywhere under pressure. We applied the first with a White machine that they invented out here in California, applying by gravity. That we had in 1908. But the last year or two we are using pressure entirely. Any one of those little horse machines of the Good Roads Machinery Company will spread any one of the cold oils very well. The hot oils we are spraying under pressure with a truck that has got heat in it, and quite a number of the companies are delivering a very heavy asphalt under heavy pressure kept hot. They deliver Standard A or B. They will deliver Montezuma on the road anywhere and spread it. Also Bermudez, and many others. That we are using on the roads where we are using the heavier asphalt.

MR. CORLEW (Utah): I don't like to bring up any particular brand of road surfacings, but I would like to ask you if you have used and what experience you have had with Tarvia B on macadam roads.

CHAIRMAN SOHIER: We have used Tarvia B, and we have used Tarite, with both good and poor results. Mr. Sharples is here and he probably would like a chance to say something about that. The Tarvia B we are using a good deal on roads originally built as tar roads. After the second year, to prevent that tar from losing its life, we are coating with Tarvia B and peastone as we would any other road, and that seems to give very good results. We have

not used as much of it as many cities and towns around our way have, of any of the tars, either Tarvia B or Tarvia A or Ugite. They have had most excellent results in Maryland with Ugite, also with Tarvia. We have got some roads we are very proud of. The Tarvia B, I don't believe is much good except when the surface is good. It doesn't contain binder enough to make the road bind. We used to use the Tarvia A and now we use the X-7, and then you will find, as they do in England, that after two years you ought to put on a surface coat.

MR. JEWKES: I do not wish to divert from the question, but before you conclude I would like to have some of your experience in the way of maintaining earth roads. I notice you stated you had a section gang every six miles. I would like to know of what number they consist and in the shaping of your roads what road machinery you use, whether a grader or a drag, and if the drag is used, what kind.

CHAIRMAN SOHIER: Well, there are a lot of gentlemen that can answer for the dirt road much better than I can. Take the road north of Boston. On that road we have to use a grader, and we are getting our best results with constant grading with the two-wheel light grader; but in the spring we would use the regular four-wheel heavy road machine to clean out the gutters. Now for the dirt road we are finding that a log drag works better than the grader, and it is much easier. We have got quite a few miles of dirt road that we are using the log drag on. By dirt road I mean dirt. I think the log drag really works better than the grader, unless you want to shape the road. It has taken twenty years to learn that sod doesn't make a good road. That is what they are apt to get with a grader. If you take the sod and throw it out of the road, you will find that some of the light shapers will grade your road better. On the other hand, take a hard gravel, and we have found we have got to use one of the graders. Is that what you meant?

MR. JEWKES: Some use the steel and some use the wooden. That is what I meant.

CHAIRMAN SOHIER: We shoe our log drag with an old buggy tire, or something of that sort. Our gang is composed of two men and a team every eight miles. Our gang for patching our oil macadam roads is the same, anywhere from seven to nine miles, where we have to have constant patching; but what we are trying to do is to resurface those roads; widen them to 18 feet, and then we practically get rid of our maintenance gang entirely, except for shoulder and gutter work.

MR. COBB: I would like to ask if you think it advisable to heat the lighter oils for the surface coat, when it is not

necessary in order to get it on the road, where it will flow by gravity without heating.

CHAIRMAN SOHIER: You understand we don't put any oil on by gravity.

MR. COBB: I understand.

CHAIRMAN SOHIER: We spray our oil under pressure, even if it is only a horse-drawn machine. If you can spread a quarter of a gallon of oil, or a fifth of a gallon with your machine, and spread it evenly, I don't believe there is any advantage at all in heating it; but we do have to heat 65 per cent. oil very often on cool mornings. I do not know whether you would have to up to 60 per cent. or not. I think very likely it would help to make easy distribution, but we don't find we have to heat any 45 per cent. oil until the temperature gets, we will say, below 60, and then quite a number of days in succession. If we want to oil, for instance, in September—we can almost always oil from the last of June to the first of September without heat,—but in the late fall or early spring we do have to heat the 65 per cent. oil.

MR. COBB: As long as you can get uniform distribution, you don't heat?

CHAIRMAN SOHIER: No, sir.

(The paper of Linn White follows.)

Comparisons of Traffic and Their Economic Value

By LINN WHITE

Chief Engineer, South Park Commissioners, Chicago

The sum of engineering knowledge, information as to the behavior of given structures or materials under certain conditions, is all empirical. We have no means of arriving at conclusions regarding any pavement or type of road construction until we have accumulated a store of experience upon which we can found our reasoning.

The fundamental elements of all road building may be briefly stated to be foundation, drainage and wearing surface. The first two are closely related, and in relative importance it is not certain but that the order should be reversed and drainage named first, as it must be first in order of construction. But omit careful consideration of any one of the three and the work cannot attain full measure of success.

If we assume that a road building proposition may be approached for the first time from the standpoint of one versed in all essentials relating to the construction of buildings, any accumulation of knowledge in that branch of the art of engineering alone will not suffice. The builder will know his foundation in its simplest form should extend be-

low the frost line or other surface disturbances; that the weight per square foot must not be more than the earth beneath can support, and that means should be taken for relieving the site of excess water. He would, in a general way, at once realize that the same sort of problems must be met in road building. If he is wise, however, he will see that they cannot be met in precisely the same way. Foundations, by reason of expense, cannot be so deep, and this very necessity of building on or near the surface introduces its own complexities and necessities of drainage.

The third element of the road building problem, the wearing surface, requires more study than foundation and drainage because it is the one element of the structure that is peculiar, and also because there are more solutions offered; therefore it is frequently true that investigation of the other essentials is overlooked. In considering the durability and success of a pavement it often occurs that a material or process is condemned or criticised when the main trouble lies deeper,—in the foundation or lack of drainage.

Of all the means of accumulating practical knowledge about road building the most fruitful is the collection of data regarding traffic, comparing and drawing conclusions from the same. Chemical analysis is another means of obtaining practical information; so is the observation of the swelling and heaving action of frost; of the disintegrating effects of frost; of the disintegrating effects of exposure to the elements, etc. But chief of all is the study of traffic.

Traffic conditions are constantly changing. This is due to three causes:

(1) The natural increase due to growth in all live communities;

(2) Evolution of methods of locomotion, such as has been witnessed in recent years when horse-drawn vehicles were being replaced by automobiles, and which is still continuing in the great increase of the auto truck; and

(3) The concentration of traffic on any thoroughfare that is paved better than its neighbors.

In the collection of data regarding traffic it is manifestly necessary to have a definite form of record to be used by the observer, that is prepared with careful consideration of the conditions. In the case of country highways or light traffic streets the observer may find it practicable to differentiate between classes of traffic that would be impossible on crowded city streets. In fact, it may easily be found on our heavily traveled city streets, where the traffic count may run up into thousands per hour, as many as four observers will be required, two on each side of the street, one to count and the other to record, while on the light traffic street one can count and have ample time to make a record with all the elaborations necessary.

For the purpose of having a complete record, all vehicles should be listed in various classes according to the ability and time of the observer to obtain details. Automobiles should at least be divided into passenger autos and freight trucks, and the latter into loaded and empty. Horse-drawn vehicles should be divided into similar classes, and record made whether one, two or more horses. Further refinement than this is of doubtful value, except merely for purposes of comparison and the satisfaction of a complete record. While two horses attached to a vehicle will no doubt have a greater effect on a pavement than one, it is very doubtful whether a runabout has on the average a less effect than a touring car.

In considering the effect of vehicles on pavement surfaces, if it were practicable to record weights and speeds, and to consider them both as functions of a result to be applied to the case in hand, there would probably be no need of making more than two classifications—horse-drawn and self-propelled vehicles. Self-propelled vehicles have certain well recognized effects upon certain wearing surfaces. On macadam surfaces the effect is to loosen the bond and separate the particles. On asphalt pavements that are at all plastic, the tendency is to form longitudinal ruts while the horse-drawn vehicle forms waves or rolls.

After the record is made the problem is to make an intelligent application of the information collected. The increase of traffic due to conditions No. 1 and No. 3 named above, and the evolution of traffic, condition No. 2, must be understood and allowed for. Here is the difficulty of drawing conclusions from too elaborate a set of records. Confusion is likely to result rather than the definite conclusion sought for.

When an attempt is made to define or describe traffic the terms "heavy," "light" or "medium" are commonly used. As a means of drawing comparisons where the character of traffic is the same such distinction may be sufficient. They are relative terms, however, and "heavy," for instance, as commonly used may mean heavy loads or a large number of vehicles. Applied to the latter case it is a misnomer. Some other term should be used to convey the idea of a large number of vehicles. For instance, "dense" or "intense." Intense heavy traffic would then mean a large number of heavy loads. Intense light traffic would then express such traffic as exists on the boulevards of our larger cities where the average weight of the vehicles is less than a ton. Conversely there should be a term to express the opposite of intense. "Infrequent" has near the right shade of meaning.

After the record of traffic has been made and after the present and probable further conditions are properly classi-

fied, the result should be something tangible and useful. Other considerations besides the amount of traffic and effect of traffic very often (one might say generally) determine the character of the highway to be constructed or the street pavement to be laid. There are communities where a brick surfaced road, whether town street or country road, represents the ideal, and, when money enough is available for its construction no other kind of pavement has any chance. Other communities almost naturally run to concrete surfaces; thanks mostly to the comparatively recent splendid efforts of the publicity departments of cement manufacturers' organizations.

Others still, like much of the great state of California, by reason of the native production of oils and asphaltic road materials, take naturally and quickly to some type of bituminous construction.

Any mere tabulation of local traffic records cannot change these tendencies. Brick for street and road purposes is universally made about so much in thickness; concrete roads will be built to certain standards whether the traffic records show 2,000 or 5,000; macadam roads with or without bituminous binders are more flexible in their character of construction and should be designed to more definitely correspond with the stress to be put on them.

Even here, however, the local engineer can make but little of immedite practical value out of his local traffic records. The movement must be larger. It rests more with public highway commissions, counties cooperating with state, with highly organized street departments of the large cities, and perhaps with consulting highway engineers of large practice, to get tangible results out of traffic statistics and records.

Every street or highway engineer should consider that the best service he can render and the greatest benefit he can receive pertaining to this matter is through general publicity and broad comparison of accumulated traffic records.

Discussion by H. K. Bishop

Formerly Superintendent of Public Works, Territory of Hawaii

The subject of traffic and some scientific and practical method of comparing the results obtained by the traffic census is one which today has received very little attention. That the amount and character of the traffic which a highway to be improved must sustain, bears a very important part in the selection of the particular type of construction to be used, is generally admitted. The volume of traffic is important; but the character, such as the percentage of motor-propelled vehicles, weight of loads carried, the speed at which motor vehicles are propelled, width of tires of horse-drawn vehicles, weight of loads drawn, and other factors,

are equally important in making a scientific comparison of traffic and its effect on the various types of roadways.

The practical engineer is very apt to pass up the traffic census and its value in determining the selection of a proper surface for a roadway to be improved, and to depend upon the individual judgment of the engineer most directly connected with the work in that vicinity. He is inclined to dismiss the traffic census as too theoretical and visionary. This view is due perhaps to the fact that at present there is no uniform method of comparing the results obtained by such a census.

All highway engineers are well aware that a roadway subject to heavy horse-drawn traffic will need an entirely different treatment than that for a roadway subject to heavy motor traffic, especially if such traffic be of the high-speed touring class.

Two censuses taken on different highways might show the same number of traffic units when reduced to some uniform measure, such as weight per foot of width, and yet the type of surface selected for the one and which might prove entirely satisfactory, would be unfit for the other. The writer has in mind a suburban highway of one of the large cities of New York State which is subject to a very heavy horse-drawn trucking traffic to and from the public market. A census taken of the traffic on this highway when reduced to tons per foot of width per 24 hours, showed almost exactly the same result as a census taken on another highway on the Southern shore of Long Island, and upon a road which is subject to a heavy traffic of motor-driven vehicles consisting largely of the touring class traveling at high speed. The first of these highways required a well-constructed brick pavement on a concrete base, while the latter was surfaced with a trap rock macadam on a natural gravel foundation. This trap rock macadam was oiled each year. The pavement described in the second case was entirely satisfactory under the conditions of traffic prevailing, and was comparatively easy to maintain. A similar construction tried out in the first case was entirely inadequate and absolutely unable to withstand the traffic conditions. The brick pavement constructed on a concrete base, has proven entirely satisfactory, and adequate to withstand the heavy trucking traffic. The above illustration demonstrates the necessity of care in attempting to determine selection for a road surface without a careful analysis of the character of the traffic both present and future.

Many attempts have been made to apply weights in the various kinds of traffic, and in this manner to reduce the results of the traffic census to a uniform basis. The writer is not aware that any of these attempts have taken into ac-

count the speed at which the various vehicles are moving. Furthermore, it is a question in the mind of the writer whether any attempt to judge the speed at which motor vehicles are traveling, by an individual observer, would be successful. That speed is important there can be no question and that it should be taken into consideration in the comparison of any traffic censuses, the writer is firmly convinced.

For the purpose of comparing the annual cost of the various types of road pavements attempts have been made to reduce the results of the traffic census to a uniform basis of tons per unit of width of pavement.

The traffic census serves a two-fold purpose—first: to furnish information to guide in the selection of a suitable surface for a road to be improved; second: to furnish units to compare the annual cost of the various types of pavement. In the first case the results of the census taken on any highway to be improved, should be considered carefully in detail and with a proper allowance for future increase in traffic after improvement. In this consideration the speed of the vehicles may be judged in a general way by the class recorded. This might be checked up by some actual observation of the speed of the various classes of vehicles in that locality. In the second case where the actual annual cost of any type of service is known the observed results of the census may be weighed and reduced to uniform units and thus the annual cost may be made on a uniform basis.

The Committee of the American Society of Engineers on Materials for Road Construction, and on Standards for their Test and Use, of which the writer is a member, presented to the society in their report, dated January 20, 1915, a set of standard forms to be used in taking a traffic census. As yet the committee has not presented any proposed uniform method for comparing the results obtained by the traffic census. Perhaps the next report of the committee, to be presented next January, will contain something along this line.

Many highway engineers will contend that the taking of the traffic census is a waste of time and money, and that it cannot be used to any advantage in any way in determining the kind of construction to be employed in any particular case. The practical highway engineer is very much inclined to make his decisions with regard to the types of road surface necessary on roads to be improved from his own personal knowledge of the conditions and from such knowledge as he is able to obtain from his subordinates, or from residents located in that particular locality. He is very apt to look scornfully upon any theoretical method of comparing traffic census. The writer must confess that he

has been inclined to this view himself in the past. However, the great growth of the good roads movement and the appropriation of large sums of money for road improvement, and especially the changed conditions of traffic, have led him to believe that we cannot get too much light and information to aid us in making the proper selection of the types of road surfaces to be used in the future. The writer is convinced that the theoretical side of road building should receive more attention, and especially that some uniform method of comparing the results obtained from traffic censuses should be evolved.

Inasmuch as the object of this paper is to open this subject for discussion, the writer will refrain from inflicting his views at any great length upon you. It is to be hoped that the discussion following the presenting of this paper will bring out many things that are new and many things that will be of future value on this subject. There are many of you who have had splendid experience and who are very capable judges of the value of such a census, and the value of deductions drawn from a comparison thereof. It is to be hoped that you will all present whatever knowledge and light you may have upon this subject.

CHAIRMAN SOHIER: The next subject on the program is "Maintenance, Materials and Methods." The paper on the subject is by A. W. Dean, Chief Engineer of the Massachusetts Highway Commission. As Mr. Dean is not present, it will be read by title and printed in the Record.

Maintenance: Materials and Methods

By A. W. DEAN
Chief Engineer, Massachusetts Highway Commission

The date of completion of construction of a roadway surface marks the date when maintenance must commence. The materials and methods to be used are governed by the type of the constructed surface; the urgency for prompt attention to maintenance is governed by the type of surface and by the quantity and quality of vehicular travel over same; the cost of maintenance is governed primarily by the judgment used in selecting the types of surface for the roadway when constructing it. Too often necessity requires the construction of an inferior surface where a paved surface should be laid, thus permitting a temporary economy in construction that is soon balanced by an excessive charge for maintenance and renewal.

Maintenance is brought to its lowest terms when the roadway surface has been properly designed and constructed. A properly built roadway is that which has been properly

designed to withstand existing and anticipated traffic and other conditions, and has been built with good quality of material and workmanship. If all roadways were so built, the maintenance problem would cease to be a problem, and there would be little occasion for conventions and discussions by road makers. This condition will never be reached, however, and we have now and for generations to come will have the countless problems of maintenance to solve.

The terms "maintenance" and "repair," while not entirely synonymous, will, however, be herein considered as such, in order to permit as broad a treatment of the subject as possible in the fewest words.

According to statistics compiled by the U. S. Office of Public Roads, over 90 per cent. of all roads in the United States are earth roads (about 2,000,000 miles), hence it must be conceded that earth road maintenance is of the utmost importance in this country. The prevailing obstacle to proper maintenance of earth roads is lack of surface and subdrainage. Surface drainage should be provided for by constructing and maintaining the roadway with proper and sufficient crown, and by providing proper side drains or gutters and culverts. When a road is built on a long steep grade on a sidehill, culverts should be placed frequently to carry the water across and under the road rather than (as is quite common) constructing so-called water bars to carry the water across and above the surface of the road. A grader or road machine should be used on earth roadways not more than twice a year, and preferably not more than once a year. It should be used with care. If sods and improper material have accumulated on the edges of the roadway and are pulled over to the surface of the road by the grader, they should immediately be thrown or carted away from the surface. A road drag is almost indispensable in the maintenance of a proper surface on an earth roadway. The drag should be used frequently and when the earth is moist. It is of no value when the earth is very dry and is of little value when the earth is very wet. The drag will not fill large depressions such as occur at each end of a bridge, but will keep the roadway in fairly good condition for travel at all times, if properly used. Where large depressions occur in a roadway, it is not good practice to place broken stone or coarse gravel in such depressions, as such practice has a tendency to cause a hard section with a hole at each end of the same.

Roads constructed with a mixture of sand and clay (sand-clay) may be considered as earth roads in an advanced stage. The ordinary maintenance of sand-clay roadways is best effected in the same manner as earth roadways. Where soft mud holes occur in sand-clay roadways, it is advisable

to fill such places with sand, as in general such holes are caused by an excess of clay in the mixture. Oftentimes such roadways are not constructed with the right proportions of sand and clay in the original mixture, in which case the maintenance of the roadway will depend upon the condition due to the excess of one material or the other. If the entire surface of the roadway is quite soft and ruts badly during wet weather, it is evidence that there is an excess of clay. Therefore, in the maintenance of the roadway under such conditions, a thin layer of sand should be spread over the surface, and if the conditions are sufficiently bad to warrant, the sand should be harrowed into the surface. On the other hand, if the surface does not become compact, but rather shows indication of being sandy, a small quantity of clay should be spread upon the surface. As in the case of the ordinary earth roadway, proper surface drainage and sub-drainage should be provided to take care of the excess of surface and ground water.

Gravel surfaces are frequently maintained to a certain extent by the use of the drag. A road machine should not be used on gravel surfaces except when it is desired to widen the traveled way or to lightly smooth the surface. Whenever a road machine is used on a gravel roadway for widening the traveled section, great care should be taken to remove from the surface any material other than gravel that may be brought on by the use of the machine. Ruts or depressions occurring in a gravel roadway should be repaired by filling lightly with gravel as near the same quality as that originally used in the surface as is obtainable. The maintenance of a gravel roadway is greatly assisted by applying uniformly at the rate of about ½ gal. per sq. yd. once each year, an asphaltic oil of about the maximum consistency that can properly be spread at air temperature with a common distributor. Such application not only furnishes a small amount of binder for the upper surface, but prevents the dispersion of the surface in the form of dust. The gravel surface herein referred to consists of material in which the mixture of round stones and particles is quite uniformly variable in size from minute particles to stones 2 or 3 ins. in diameter. This definition is given on account of the fact that there are so many different ideas conveyed when the term "gravel surface" is mentioned.

The maintenance of a broken stone macadam (water bound macadam) roadway whenever constructed by the usual method is a more or less difficult problem, depending upon the traffic that it has to withstand. If the traffic consists largely of steel-tired vehicles, with very few rapidly driven motor vehicles, a macadam roadway may be maintained by keeping its surface covered with a light layer of sand or

other suitable fine material, the object of this covering being to keep sufficient binder on the surface to prevent the stones in the surface from picking up. If, however, the traffic is sufficient to wear out the surface rapidly, as is the case when there are many motor-driven vehicles, and particularly when there are many rapidly driven motor vehicles, the sand surface cannot be maintained and it becomes necessary to use some other means of maintenance. The use of a bituminous binder in the construction and maintenance of macadam roadways has now become quite universal, and the problem of maintenance of bituminous bound or surfaced roadways has now become simple. Applying about ½ gal. per sq. yd. of an asphaltic oil or refined tar at proper intervals permits of maintenance of macadam roadways under ordinary traffic for a long period, provided the subsequent applications are made at proper intervals. The interval between applications cannot be definitely stated, but can be determined only by the appearance of the surface of the roadway. In Massachusetts it has been the practice during the past several years to maintain water bound macadam roadways by surface applications of so-called "cold oil," the oil used being what is termed by the manufacturers as a "50 per cent. oil." It has been found that one application per year is sufficient on most of the roadways where maintenance is effected in this manner. The method of applying the oil is as follows: First, the road is swept lightly to remove all surplus material from the surface. The oil is then applied by means of a pressure distributor, thus insuring a complete and uniform covering. Immediately thereafter, coarse sand is spread in sufficient quantity to entirely cover the oil. The amount of oil used in the first application is approximately ½ gal. per sq. yd., and on subsequent applications the amount varies from 1/3 to 1/5 gal. per sq. yd. The asphalt contained in this oil forms a thin carpet on the macadam surface, and not only prevents wear, but prevents distribution of dust. It has been found that the use of heavy oils such as are known to the trade as "90 per cent. oils" assists in a satisfactory maintenance for only one or two years, after which the bituminous material has a tendency to crawl and become wavy. The lighter oils, having less body, do not have this objection. Refined tar is often used in the same manner as described above in the maintenance of macadam roadways and often gives quite satisfactory results.

Repairs on a bituminous blanket or thin surface coat may be made by covering the section to be repaired with a thin coat of asphaltic oil or tar, as the case may be, and immediately covering with peastone, fine gravel or coarse sand. This is assuming that the repairs consist of renewing com-

paratively small sections of the coating that for any reason may have disappeared. No general fixed method can be described for making repairs due to imperfect workmanship, the use of too much bituminous material, or the irregular distribution of material, each case having to be treated in such manner as experience may have shown to be best. Renewals of bituminous carpets may ordinarily be made by a repetition of the usual process of constructing such carpets, except that it is advisable always to use less bituminous material per square yard for renewal than was used in the original carpet.

So-called sand and oil mixed road surfaces are either repaired or renewed by the addition of mixed material of the same quality and density as that used in the original surface.

Bituminous grouted or mixed macadam surfaces should not require early or frequent repairs or renewals if designed and constructed properly in the first instance. Should the necessity for repairs arise, however, they are ordinarily made by the removal of disintegrated or imperfect portions of the surface and substituting therefor a mixture of bitumen and small broken stone, the mixture being made either by mixing previous to application or by spreading stone and filling the voids by pouring.

In renewing bituminous macadam surfaces it is not ordinarily necessary to break up or remove any of the existing surface, but the new surface may be added by spreading directly over the old surface. If, however, the old surface in addition to having become worn thin is worn very irregularly, it is advisable to loosen up, scarify, reshape and roll the old surface before adding the new surface material.

The repair of cement concrete surfaces is a comparatively new problem, as such surfaces have not been in use for many years, and such repairs as have been required have been due to imperfect workmanship or material. If the defects to be repaired consist of badly disintegrated sections, they cannot be permanently repaired except by the removal of all material in the sections to the full depth of the surface and replacing same with new and proper concrete. If the defects to be repaired are minor, however, and consist merely of small depressions, they may be repaired by filling the depressions with a bituminous mixture. When a cement concrete surface becomes worn sufficiently to appear to require renewal, it is impossible to renew the same by adding a new thin coat of cement concrete mixture; therefore it may be said that a cement concrete surface cannot be renewed with the same type of surface, but must be entirely removed and a new section constructed. This would be expensive, however, and it appears that the proper method for bringing up an old concrete surface is to cover it with

a bituminous bound surface in place of a cement concrete surface.

Block pavements of all kinds can be repaired or renewed only by the entire removal and replacement of the sections to be repaired or renewed.

CHAIRMAN SOHIER: I am now going to introduce a gentleman who really knows something about what he is talking about, and that is Mr. W. H. Connell, Chief of the Bureau of Highways and Street Cleaning, Philadelphia, Pa. (Applause.)

MR. CONNELL: Mr. Sohier put me at a disadvantage by stating he was going to introduce somebody that knew something. That might be all right if I had not immediately followed the chairman's long and instructive talk. I am going to deal with two phases of the road problem, both I think of equal importance. One is in the pure business management of road work. It is easy enough to eliminate the dust, to apply bituminous materials and do all of those things that are essential to having dustless roads, if you go about it in the right way. That means doing exactly the same as you would in handling a business proposition. Pick out a man or men whose training has been along those lines. If your own money were at stake and you were running your own business, you would make sure that you would pick out men who were more or less expert in the particular line of your business. The same problem applies to the elimination of dust and street cleaning. That is simply plain common sense and logic. The title of this paper is "Dust Suppression and Street Cleaning."

Dust Suppression and Street Cleaning

By WILLIAM H. CONNELL
Chief, Bureau of Highways and Street Cleaning, Philadelphia, Pa.

There is probably no phase of public work with a more direct bearing on the comfort and convenience of the public than the suppression of dust and the cleaning of streets. Realizing this, the public is becoming more and more exacting with regard to the means adopted by the different cities and communities to cope with this problem. Evidence of this is the widespread interest of the business and civic organizations throughout the country which are endeavoring to cooperate with the officials in charge of the work, in order that the streets in their respective communities may be clean and free from dust. Until a few years ago, the civic organizations were confined to the cities, as the dust nuisance did not assume any great proportion in the

outlying districts where the travel was over country roads, until the advent of the automobile. But now the widespread interest backed by civic organizations for the suppression of dust is probably just as prevalent in the outlying districts as in the cities. This is simply illustrative of the fact that the public is tired of the slipshod methods formerly used, and still in use in many localities, in connection with the dust suppression problem on country roads, all of which is an indication of the evolution through which this country is passing today with regard to the solution of problems pertaining to the public service, and coming under the jurisdiction of the federal and state governments, municipalities and townships. We are, however, still floundering about and until it becomes universally recognized that all such problems must be handled by experts in the respective undertakings, such as is the case in business, we will continue to grope in the dark. This is evidenced probably more in street cleaning work than in any other branch of public work in this country, and it is simply due to the fact that it has lacked expert supervision, and more so than any other field of the public service.

With the advent of the automobile, and the keener sensibilities of the public, due to higher and more universal education, and the fact that the world is becoming more progressive in business and scientific undertakings every day, the people are actually demanding all the comforts that heretofore have been denied them and which common sense tells them are within their grasp. Included in this category and under the title of street cleaning, is the problem of the elimination and suppression of dust on paved streets and country roads. This is simply an engineering problem that can be successfully handled in every section of the country today. All that is necessary is to employ qualified experts to advise and outline methods of carrying on the work and to place competent men in a supervisory capacity. This puts part of the burden of the responsibility where it belongs—with the people. In order to have good service, plain business principles similar to those employed in private undertakings must govern in the selection of those charged with the solution of the problems of the public service.

The public is said by some to be overly exacting with public officials. Though not so in a general sense, in many instances people are unreasonable in their demands and have extravagant views which do not represent the good, sound judgment that they would put into practice in their own business undertakings. Public business is said to be and is everybody's business, but unfortunately, generally speaking, opinions are often expressed on matters pertain-

ing to public affairs without knowing the facts, which policy would be disastrous to pursue in business life.

In many ways the people are like children—they want something and want it badly, but do not care how they get it so long as their individual requests are granted, never considering whether the existing finances of the community will warrant granting their demands, as they usually consider such matters from their viewpoint alone. In other words, the collective requests of a somewhat similar nature, are subordinated to their personal desires, and they refuse to consider that the expense might make it prohibitive to comply with their demands. Very often, too, when they do go into the financial situation and find that there is no money available for certain purposes and that certain things never can be as they should be until more funds are provided, they are unwilling to pay their share of a raise in the taxes to provide the comforts that they demand.

As this is due to a lack of knowledge in matters pertaining to the public service, it can only be overcome through a campaign of publicity designed to educate the people and bring them to a realization of the fact that these problems are simply business and engineering ones and should be handled by competent authorities.

In discussing an engineering subject such as street cleaning and dust suppression, the scope must necessarily be sufficiently broad to place the matter in its true light, and the foregoing is simply a brief outline of some of the elements entering into this problem and the obstacles and difficulties to be met, and that are met with by engineers in charge of departments supervising work of this character.

It is not only the technical problems that should concern the engineer in charge, but the whole question of public policy and public cooperation is, and should be, just as much his business as are the engineering problems, and it would therefore not be doing justice to this subject to outline the methods of carrying on the work from an engineering standpoint without first endeavoring to point out that the human problem is also a very important factor. Any community can eliminate dust on country roads and city streets, if it will consider the matter intelligently as any individual would in conducting his own business affairs, and employ qualified experts to advise, or supervise the work, a practice which, if universal, would save the communities throughout the country millions upon millions of dollars each year.

Street Cleaning

The street cleaning problem grows in importance, depending upon the area of paved streets under control, the traffic and population of the community and how apportioned. In a small community it is a somewhat simple one, but very

complex and difficult in a large city. It might be said that it grows in magnitude with the density of the population, as traffic naturally increases in proportion and advances with the population.

No hard and fast rules can be laid down as to the number of times streets should be cleaned, except that it should be done often enough to not only have them appear cleanly, but to prevent the dust from becoming a nuisance between cleaning periods. The number of cleanings the respective streets require in order to accomplish this purpose depends upon the general cleanliness and habits of the people and the volume and character of traffic. In a neighborhood where the people are uncleanly in their habits and litter the streets with paper, fruit skins, etc., it is necessary to clean more frequently than in a locality where even though the traffic is the same, the streets are not constantly being littered with rubbish.

The two important considerations in street cleaning work are as follows:

First, to secure the cooperation of the public, and if necessary to enact and enforce laws compelling the people to do their part by refraining from littering the streets with rubbish and store sweepings. Unless this can be effected by public cooperation or through the enforcement of the law, it will be impossible to keep the streets clean no matter how often they are cleaned.

Second, the actual cleaning of the streets.

In order to give a general idea of how this work is carried on in a large city, the following outline of the manner in which this work is performed in Philadelphia will represent the general methods used.

The street cleaning work is under the jurisdiction of the Highway Bureau, which also has charge of the construction and maintenance of all classes of streets and roads, and the collection of ashes, rubbish and garbage. It is directly supervised by division and district engineers, who are also in charge of all classes of work in their respective districts. The street cleaning force is uniformed; the methods of cleaning are by horse-drawn flushers, automobile flushers, squeegees, machine brooms and hose flushing. In addition to these methods of cleaning, which are carried on in accordance with a fixed schedule stipulating that each street shall be cleaned at stated intervals, blockmen, whose duties consist of pick-up cleaning, are stationed throughout the city. This work is supplemental to the regular schedule of machine cleaning. The area covered by these blockmen varies from 4,000 sq. yds. in the central business section to 20,000 sq. yds. per blockman in the outlying sections, and depends upon the amount of cleaning required in the dif-

ferent sections of the city. Flushers are used almost exclusively on stone block pavements, the water being applied under a pressure of 40 lbs. per sq. in. The purpose of the flushing is to remove the dirt from between the blocks. Machine brooms are also used on block pavements, and smooth pavements that are in bad repair and cannot be satisfactorily cleaned with the rubber squeegees. The most efficient method of cleaning smooth pavements, such as wood block and sheet asphalt, appears to be with the rubber squeegee. This may be demonstrated by thoroughly cleaning a pavement with a machine broom and after it has had a chance to dry out, observing the dust rising from the street when an automobile passes over it. On the other hand, after cleaning a pavement with a squeegee, it will be observed that there will be no dust rising from the street as the automobile passes over it. This is due to the thorough scrubbing of the pavement with the rubber squeegee, while the broom leaves streaks of dirt, which, though they are very slight and can be disclosed only by close observation, create a certain amount of dust. The disadvantage of cleaning with squeegees, and in fact with most of the present day methods of cleaning, is that in freezing weather they cannot be used, since it is necessary to sprinkle first and this results in coating the pavement with ice.

The solution of the street cleaning problem would, therefore, appear to be some sort of vacuum cleaner that would make it unnecessary to wet the streets in the winter. No vacuum cleaners are used now in Philadelphia, but before very long this method of cleaning will supplant many that are in use at present. The mechanical contrivances used to-day in the cleaning of streets are very crude, which is directly attributable to the lack of engineering supervision in this class of work. It is only within the last few years that in some sections of the country this phase of the situation has been seriously considered and studies are being made with a view to improving upon the present equipment.

The schedule under which this work is done is a result of studies made to determine the frequency of cleaning required on each street, with a view to eliminating the dust nuisance on the 1,165 miles of paved streets in the city of Philadelphia. The country road bituminous surface treatments have accomplished the same results on the 242 miles of macadam and 204 miles of dirt roads.

Street cleaning in the city of Philadelphia is done under annual contracts, the city being divided into eight districts. The work is under the supervision of the district engineers of the Highway Bureau and their corps of inspectors.

The specifications provide for the cleaning of all streets 6 ft. 6 ins. in width or over, either by machine brooms, squeegees or flushers, and the equipment to be operated in accordance with a schedule which specifies the streets in the order in which they are to be cleaned with the various types of equipment. Squeegee machines, high pressure flushing machines and sprinklers are not used when the temperature conditions are such as to make their use undesirable, due to causing slippery streets in freezing weather. During the winter when this work cannot be done, additional machine brooms and gangmen must be provided to clean the streets with the frequency called for.

The total amount of yardage cleaned every day is 1,354,364 yards, cleaned every two days 9,955,031 yards, cleaned every three days 5,712,118 yards, and cleaned once per week 441,-110 yards, which makes an average cleaned per day of 8,-309,437 yards. The total yardage of streets to be cleaned in this manner is 17,413,101. In addition to this the specifications provide for the cleaning of suburban and country streets and roads, of which there are 523 miles, and of alleys from one to six times per week, depending upon the necessity. There are approximately 12,000 alleys in the city under 6 ft. 6 ins. in width.

The specifications also stipulate that the contractor must furnish a certain number of blockmen for each district, fully equipped with the necessary bags and bag carriers, scrapers, brooms, sprinklers, etc. The number of blockmen ranges from 45 to 140 per district. A certain number of hand machine brooms, squeegees and flushers are also specified for each street cleaning district.

All blockmen and gangmen wear white uniforms with white helmets in the summer months and white caps in the winter months. All drivers and helpers wear khaki uniforms with khaki canvas hats in the summer and caps in the winter. Superintendents and foremen wear dark gray uniforms and caps. Inlet gangs are uniformed in khaki with hats in the summer and caps in the winter.

The following is a description of the methods of handling this work, which is divided as follows: (1) Hand patrol; (2) Machine broom cleaning; (3) Squeegeeing; (4) Flushing; (5) Alley cleaning; (6) Country road cleaning.

Hand Patrol.—The blockmen are assigned to sections designated by the Chief of the Bureau of Highways and Street Cleaning, the area to be covered by each blockman depending upon the character and amount of traffic and ranging from 4,000 to 20,000 sq. yds. per day. The duties of the blockmen consist of patrolling these areas, gathering all paper or other refuse, and sweeping street dirt as it accumulates and placing it in dustproof bags or metal cans,

DEPARTMENT OF PUBLIC WORKS, BUREAU OF HIGHWAYS AND STREET CLEANING, PHILADELPHIA, PA.

Street Cleaning Cost Data Monthly Statement, 1915.

Class of work.	Square yd. cleaned per month.	Cu. yd. of dirt removed per month.	Per cent of Work.	Per cent of Cost.	Actual cost: Tot. cost from dist. force and equipment report	Actual cost: Unit cost: To clean per 1,000 sq. yds.	Actual cost: Unit cost: Per cu. yd. dirt.	Cost by contract: Total cost monthly sum paid by city.	Cost by contract: Unit cost: To clean 1,000 sq. yds.	Cost by contract: Unit cost: Per cu. yd. dirt
Machine broom....	144,424,000	22,372	62.3	42.9	39,462	.273	1.77	44,074	.305	1.97
Squeegee	48,051,000	1,538	20.8	9.4	8,678	.170	5.66	9,657	.200	6.28
Flusher (horse) ..	8,044,000	[2]....	3.4	1.7	1,560	.194	..	1,746	.217	..
Flusher (auto)	[1]3,180,000	[2]....	1.4	0.8	780	.200	..	822	.258	..
Alley cleaning	8,046,000	856	3.4	4.3	3,972	.494	4.64	4,418	.550	5.16
Hose flushing	807,000	[2]....	0.4	0.4	397	.492	..	411	.510	..
Roadwork	19,175,000	5,144	8.3	7.7	7,059	.368	1.37	7,911	.413	1.54
Inlet cleaning	[3]....	3,426	..	4.2	3,864	.018	1.13	4,315	.020	1.26
Blockmen	[4]147,993,000	7,458	..	28.6	26,380	.178	3.54	29,383	.198	3.93
Totals	[4]231,727,000	40,794	..	..	92,152	..	..	102,737	..	..
Average	....	0.177 cu. yd. per 1,000 sq. yd.	..	..	machine work [5]hand work	.248 .394	2.10 1.84	machine work hand work	2.76 .455	2.55 2.12

[1]Auto flusher cost is based upon 75,000 sq. yds. cleaning per day flusher at a charge of $15 per day (10 hr.) per flusher. Flushers finish their schedule and help on horse flusher and squeegee routes. [2]Dirt removed by blockmen. [3]Approximately two inlets per 1,000 sq. yds. [4]Blockmen yardage not included in total. [5]Hand work does not include inlet or blockman work.

NOTE: The above costs include the collection and disposal of the dirt gathered, and are based upon rate per ten hour paid by the contractor for labor and equipment. These rates are as listed below.

Blockman work consists of pick-up cleaning and is entirely supplemental to machine cleaning.

Water cost is not included in the above figures. This cost at 4 cents per 1,000 gallons amounts to $15,555.36—388,884,000 gallons being used.

Cleaning area of paved streets and country roads—1,408.2 miles—21,248,318 sq. yds.

Computed annual cost—Total $1,101,792—per mile $782.35—per 1,000 sq. yds., $51.85.

Annual cost to city by contract, $1,232,847—per mile, $875.55—per 1,000 sq. yds., $58.02.

Population (estimated 1915), 1,675,000. Cost per capita—computed $0.658, contract $0.736.

Contractor's Labor and Equipments Rates Used in Above Computations.

Superintendent, $4 per 10 hr. day; blockman, $1.50 per 10 hr. day; machine broom (driver and 2 horses), $5.50 per 10 hr. day; foreman, $2.50 per 10 hr. day; dirt wagon (driver and 2 horses), $5 per 10 hr. day; squeegee (driver and two horses), $6 per 10 hr. day; assistant foreman, $2 per 10 hr. day; dirt cart (driver and one horse), $3.50 per 10 hr. day; flusher (driver and 2 horses), $7.50 per 10 hr. day; gang laborers, $1.75 per 10 hr. day; sprinkler (driver and two horses), $5 per 10 hr. day; flusher (auto), chauffeur and helper, $15 per 10 hr. day.

after which these bags or cans are collected and loaded into special wagons and hauled to a collection station or dump.

The equipment used in the hand patrol work consists of hand machines, bag carriers, burlap sacks, push brooms, pan scrapers, sprinkling cans and shovels. The dirt collected is placed in sacks and left at convenient points to be taken away by special wagons to the dump, the sacks being returned to the drivers. Sacks are generally used in preference to cans because of the weight, bulk and noisiness of the latter.

Machine Broom Cleaning.—All machine broom cleaning is done in batteries of two or three, preceded by sprinklers, the number of brooms in each battery depending upon the width and character of the streets to be cleaned, the average gang consisting of two machine brooms, one sprinkler, four to seven gangmen, and a sufficient supply of carts or wagons to remove the sweepings, the number depending upon the length of haul to the dumps and the season of the year, together with the amount and character of traffic.

Squeegee Cleaning.—Squeegee cleaning is used on smooth pavements. The operation is performed by batteries of two and three squeegee machines preceded by sprinklers to soften and loosen the material on the streets, the sprinklers using as much water as possible without flooding the pavement; the squeegees using just enough water to create a wash. The idea of sprinkling in advance of the squeegees is to soften the dirt and enable the squeegees to cleanse the streets of all slime as well as of the coarser materials. The squeegees are followed by two men, who immediately sweep up the windrows of dirt into piles, and a sufficient number of carts follow to remove the dirt from the streets.

Flushing.—Flushing machines are used only on the poorly paved streets and block pavements. The high pressure flushing machines, two of which are mounted on auto trucks, are usually operated singly, as most of the districts have but one flusher.

Alley Cleaning.—All alleys and streets whose width between curbs is too narrow to permit the use of machine brooms are cleaned once each week with a hose. When such streets or alleys are required by schedule to be cleaned more than once a week the additional cleaning is done by hand brooms.

Hose Flushing.—A hose flushing gang comprises a foreman and eight men, and operates in the heavy traffic business section of the city. The work is supplemental to the regular gang cleaning and to the blockmen cleaning and is done at night. The work is slow, but thorough, the main object being to remove the fine dust and pavement detritus.

DEPARTMENT OF PUBLIC WORKS, BUREAU OF HIGHWAYS AND STREET CLEANING, PHILADELPHIA, PA.

Summary Showing Detail Costs of Bituminous Surface Treatment Work, Season 1915.

Treatment	Sq. yds treated 1915	Average per sq. yd. Gallons bitu-minous material	Pounds covering material	Average labor cost per sq. yd. Sweeping Hand	Sweeping Machine	Chipping	Clean up	Total labor
Refined coal tar—hot application—Tarvia A.....1st	206,680	.278	17.6	.00304	.00068	.00538	.00114	.01024
Refined coal tar—hot application—Tarvia A.....Re.	41,910	.201	15.5	.00265	.00036	.00483	.00078	.00860
Refined coal tar—cold application—Tarvia B.....1st	429,360	.417	18.9	.00470	.00092	.00460	.00150	.01170
Refined coal tar—cold application—Tarvia B..... 2d	326,911	.307	16.5	.00348	.00052	.00480	.00116	.00996
Refined coal tar—cold application—Tarvia B..... 3d	470,000	.235	14.7	.00284	.00035	.00421	.00126	.00866
Refined water gas tar—hot application—Ugite....1st	40,460	.278	18.0	.00304	.00068	.00550	.00114	.001036
Refined water gas tar—cold application—Ugite....1st	58,570	.417	18.9	.00470	.00092	.00460	.00150	.01170
Refined water gas tar—cold application—Ugite.... 2d	14,800	.307	16.5	.00348	.00052	.00480	.00116	.00996
Refined water gas tar—cold application—Ugite.... 3d	18,578	.235	14.7	.00284	.00035	.00421	.00126	.00866
Asphalt cutback 1st	194,396	.293	18.0	.00470	.00092	.00460	.00150	.01170
Asphalt cutback .....Re.	108,090	.201	15.0	.00209	.00049	.00310	.00071	.00639
Asphalt road oil—dust layer—21°-23° Beaume.....	1,167,790	.230	..	....	....	....	....	....
Total square yards treated.....	3,077,545	..	..	....	....	....	....	....

Treatment	Average material cost per sq. yd. Bit. material	Cover ing material	Total material	Average total cost per sq. yd.	Average total cost per sq. yd. first and retreatment 1915	1914	1913
Refined coal tar—hot application—Tarvia A..... 1st	.0236	.0175	.0411	.0513	.0495	.0641	.0824
Refined coal tar—hot application—Tarvia A..... Re.	.0169	.0154	.0323	.0409			
Refined coal tar—cold application—Tarvia B..... 1st	.0289	.0188	.0477	.0594			
Refined coal tar—cold application—Tarvia B..... 2d	.0213	.0164	.0377	.0477	.0487	.0566	.0658
Refined coal tar—cold application—Tarvia B..... 3d	.0163	.0146	.0309	.0396			
Refined water gas tar—hot application—Ugite..... 1st	.0222	.0179	.0401	.0505	.0505	....	....
Refined water gas tar—cold application—Ugite..... 1st	.0250	.0188	.0438	.0555			
Refined water gas tar—cold application—Ugite..... 2d	.0184	.0164	.0348	.0448	.0501	.0509	.0698
Refined water gas tar—cold application—Ugite..... 3d	.0141	.0146	.0287	.0374			
Asphalt cutback 1st	.0231	.0175	.0406	.0523			
Asphalt cutback .....Re.	.0158	.0146	.0304	.0368	.0468	.0738	.0868
Asphalt road oil—dust layer 21°-23° Beaume.....	.011	....	.011	.011	.011	.012	....

	1915	1914	1913
Torpedo gravel, per 2,000 lbs. on road.	$1.99	$2.14	$2.50
Trap rock chips, per 2,000 lbs. on road	1.94	2.30	2.30
Tarvia A, per gallon applied.....	.085	.085	.085
Tarvia B, per gallon applied.....	.0693	.07	.07
Ugite hot, per gallon applied.....	.08	.09	.09
Ugite cold, per gallon applied.....	.06	.08	.08

	1915	1914	1913
Asphalt cutback, per gallon applied.	.0788	.11⅔	.12
Asphalt road oil, per gallon applied.	.0484	.0523	..
Laborers, per 8 hr. day.....	2.00	2.00	2.00
Foremen, per 8 hr. day.....	4.00	4.00	4.00
Assistant foremen, per 8 hr. day....	3.00	3.00	3.00
	1915	1914	1913
Teams, per 8 hr. day.....	4.50	4.75	5.20

Approximately 30,000 sq. yds. can be cleaned in 10 hours by each gang. A gang is equipped with hand brooms and 150 ft. of hose with necessary attachments. One man operates the hose. The remaining men scrub the surface of the street, clean out the depressions and the gutters.

Inlet Cleaning.—All inlets on paved streets and alleys are cleaned as often as necessary to keep them at all times free from obstructions, this work being done by special inlet gangs consisting of three men and a sufficient number of carts.

Country Road Cleaning.—The cleaning of suburban and country streets and roads is taken care of by gangs, each consisting of 1 foreman, 10 laborers and 2 carts. The work consists of pick-up cleaning, trimming the shoulders, opening and keeping the gutters clean, cleaning inlets, removing all refuse, rubbish and debris from the streets, and such other work as may be necessary to keep the streets and roads in "spick-and-span" condition. The respective streets and roads are cleaned at least once every two weeks, and where necessary once or twice a week. The area of water bound macadam, bituminous and concrete streets and roads, cleaned by the country road gangs is approximately 3,835,217 sq. yds.

Snow Removal.—The street cleaning specifications also provide in case of snow for the entire forces of the contractors to be used in removing the snow, when and where directed. In order to remove the snow quickly from the central and business section of the city, separate contracts are also entered into, in which removal of snow is paid for on the cubic yard basis and in most cases it is dumped into sewer manholes at convenient locations or in the rivers.

Dust Suppression on Suburban and Country Roads.

The methods adopted to suppress the dust on the suburban and country macadam streets and roads in the City of Philadelphia are as follows:

The country and suburban streets and roads receive bituminous surface treatments of the character best suited to the respective roads, which are selected only after making a study of the type of construction, the traffic and social and local conditions in each instance. Generally speaking, two methods of treatment are used on the roads to suppress

NOTE—The following is a continuation of the table on page 406:

All Classes Materials, 1915.

Total gallons applied	847,606 gals.
Total amount covering material	16,089 tons
Total cost	$86,598.71
Average labor cost per sq. yd. for hand and machine sweeping, chipping and clean-up—during 1914	$0.02030
Average labor cost per sq. yd. for hand and machine sweeping, chipping and clean-up—during 1915	.01007
Reduction in labor cost per sq. yd., 1915 over 1914	.01023

the dust. For convenience they are divided as follows: First, into bituminous surface treatments, intended to eliminate the dust nuisance and preserve the roads; second, a cheaper method of bituminous surface treatment, used simply for the purpose of laying the dust on macadam, cinder, and dirt roads, and not intended to preserve the road.

The first method of treatment is used only on macadam roads that have been put in good condition, as it is a waste of money to put a high-class bituminous surface treatment on a road that is full of ruts and pot-holes and not properly shaped up. The bituminous materials used in the City of Philadelphia consist of coal tar treatment, hot application, known as Tarvia A; coal tar treatment, cold application, known as Tarvia B; water gas tar treatment, hot application, known as Ugite No. 2; water gas tar treatment, cold application, known as Ugite No. 1; and asphalt cut-back treatments which consist of a mixture of 60 to 65 per cent. of 80 to 100 penetration asphalt, conforming to specifications adopted by the Association for Standardizing Paving Specifications at Pittsburgh in 1913, and 35 to 40 per cent. of 53 to 60 commercial naphtha. All of these materials are applied in quantities just sufficient to paint the road and to avoid possibilities of building up a pad. In other words the purpose is simply to have a film coat of bituminous material on the surface of the road and to re-treat the road as often as is necessary to maintain the film coat, and in this way eliminate the pushing and rolling under traffic, which occurs with bituminous pads.

The method of applying these bituminous materials, when the road is in proper condition to receive such a treatment and the material to be used on the respective roads has been selected, is as follows: The roads are first lightly sprinkled with water and then swept with a horse-drawn broom. They are then swept with hand brooms until the surfaces of the stone are free from dust. This sweeping, however, should not be done in such a manner that the stone dust or binder will be removed from between the stones. The bituminous material is then applied with a pressure distributor at a certain rate per gallon which varies on different roads, depending upon their condition, and also whether it be a first, second or third treatment. The bituminous material is then allowed to remain on the road for about twelve hours or over night, after which the washed gravel—

Passing	½-in. screen.....	100	per cent.
"	No. 4 screen	50 to 60	" "
"	No. 6 "	20 to 30	" "
"	No. 10 " not over	10	" "

is spread over the road at the rate of 13 to 18 lbs. per sq. yd., depending upon the amount of bituminous material ap-

plied. In some cases clean trap rock chips passing a ⅝-in. ring and retained on a ⅜-in. ring are used.

The theory of using fine washed gravel in place of stone chips is twofold; first, to use a covering that will not grind up and pulverize before the bituminous material has set up, and thus incorporate with it and build up a pad, such as is the case with the stone chips as they pulverize very quicky under any appreciable amount of traffic; second, it contains only 10 per cent. of the fine sand and the pebbles constituting the rest of the material are so hard that they do not grind up and pulverize for from three weeks to two months, depending upon the traffic. The process of pulverizing is so slow that the fine material is washed off the road after each rain, thus doing away with the necessity of sweeping the road to eliminate the dust, which is necessary where stone chips are used.

These treatments last for a year and have proved to be not only the most economical method of preserving roads of this character, but the cost is less than the cost of sprinkling, provided the roads are sprinkled three times a day and this, by the way, is not sufficient to lay the dust, and, of course, it must also be understood that the sprinkling with water will not preserve the roads under automobile traffic.

The second class of treatment generally used consists of asphaltic road oil from 18° to 23° Beaumé gravity. This material is applied to all of the macadam roads that are not in fit condition for the first-class bituminous surface treatment and to all dirt roads, and is applied at the rate of 0.2 to 0.25 gal. per sq. yd. On some roads, depending upon the amount of traffic and whether or not the road is shaded, it is necessary to treat the road in May and treat it again in September. Such roads, however, are the exceptions. In most cases this method of treatment will last for one season. The roads as a rule are not swept before the application, nor is any covering put over this bituminous material, as it is applied in such small quantities that there is scarcely any necessity for covering. The purpose in putting on this small quantity is to insure its disappearing from the road before the winter sets in, in order to avoid the mushy condition that prevails when there is too much oil on the road in this season of the year.

The paint coat method of tar bituminous surface treatments on first-class macadam roads has been a success for seven or eight years in this country, and it has also been used to a very great extent for a number of years in England.

The asphalt cut-back paint coat treatments are somewhat new, and have been largely developed in Philadelphia during the last four years. The successful results in Philadelphia

have led to their use in other localities in the east this year, notably by the Highway Department of the State of Pennsylvania, where a large mileage of roads have been treated using this method.

The asphalt cut-back bituminous surface treatment was evolved through research work carried on with a view to finding some way to utilize an asphalt in the paint coat method of treatment which had been so successful with the tars. In order to do this, it was necessary to use a comparatively stiff asphalt so that it would set up quickly on the road. This necessitated cutting back an asphalt of about 100 penetration with from 35 to 40 per cent. of naphtha. The purpose of the naphtha is to make the material of such a consistency that it can be applied to the road when it is moderately warm. In other words, the naphtha simply acts as a carrying agent and after it has done its work, it evaporates and leaves the paint coat of asphalt on the road.

This material has proved to be a success under a four year test, re-treating, of course, every year or two, or as often as is necessary, as is also the case with the tars.

The methods of bituminous treatments described, however, are not applicable to all conditions. The roads treated must be built of comparatively hard stone, and the traffic conditions must be taken into consideration.

It is impossible in the limited time allotted to this subject to go further into the details of street cleaning and dust suppression, but the tables (pages 404 and 406) will give an idea of the cost of cleaning the 1,425 miles of paved streets and country roads under the different methods in use, and of applying the bituminous treatments of different characters for the suppression of dust on the 242 miles of water bound macadam and earth roads in the City of Philadelphia.

MR. CONNELL (continuing extempore): The costs of course all depend on the cost of material. For instance, in Philadelphia for this gravel stone chips, we pay about $2 to $2.20, whereas in the Borough of the Bronx they pay 95 cents a cubic yard delivered on the road. That of course reduces their cost. The cost of the first, second and third treatment based on all the details, rate of wages and cost of materials which are given here you will see printed in the proceedings. They are about as follows: We find tar, hot application, first treatment, 5 cents; second treatment (I am reading the nearest whole number), 4 cents; refined coal tar, cold application, Tarvia B first treatment, about 6 cents; the second treatment, 5 cents, the third treatment, 4 cents. Of course the cold material is cheaper than the hot material. We put on a greater quantity per square yard and we treat a road heavier. With the hot materials we put on just

as little as the road will take. In some cases we put on two-tenths or a quarter of a gallon, seldom go over a third, and we only put a third on when the road is more or less open. With the Ugite, the hot application is 5 cents, and with the cold application, the first treatment is 6 cents, the second 4.4, the third 3.7. With the asphalt cut back the first treatment is about 5 cents and the re-treatment about 4 cents. They run pretty close in cost all the way through. The asphalt cut back treatment in 1913 was about 9 cents to the square yard, 1914 7 cents, 1915 5 cents. This is due to two things, one is that the 1915 treatments are mostly re-treatments, and the other is that the naptha has gone away down in price, making this material cheaper than it formerly was. The tar treatments have also gone from 1913, 8 cents; 1914, 6 cents,—this is an average of all classes of hot treatments—1915, 5 cents. Now the coal tar, the Tarvia B treatment, 1913, 7 cents; 1914, 6 cents; 1915, 5 cents. That is not due to any decrease in the price. There is a slight decrease in the price in the bituminous material, but that is entirely due to the fact that the organization is an old one. It was a brand new one in 1913 and the men never had put any of this kind of material on and knew nothing about it. Now as they are becoming more accustomed to it they are reducing the cost, and of course we have considerable rivalry between all the different units of the organization, because we have a complete unit cost system operating.

The street cleaning cost per thousand yards are as follows: The machine broom, 30 cents; squeegees, 20 cents; the horse flusher, 22 cents; the auto flusher, 25 cents. That horse flusher cost doesn't amount to anything because we have eliminated the horse flusher from our work. There are two kinds of horse flushers. One is a flusher where you get the water pressure from the hydrant and the other is a gasoline pump, the Studebaker machine. Where you have a high pressure in the hydrant that horse flushing is a good method to use, but we have a low pressure in the hydrants in Philadelphia, and we can't get pressure enough on the pavement, and the gasoline machines horse drawn are out of order about one-half of the time. So if you took that into consideration, the cost would be about double what it is. They are not really an efficient method of cleaning. We have abolished them in favor of the auto flusher, which we have been experimenting with this year, and it looks today like the very best thing for cleaning stone block pavement other than the hose cleaning, which is expensive. We have a couple of flushers and we are going to add six more this year. Alley cleaning runs about 55 cents. That is due to labor cost; hose flushing, 51 cents. That is due to labor cost. The road cleaning we do is all labor, and that

amounts to about 41 cents a thousand yards. I have the percentage of the work of each class of cleaning to the work as a whole, and the percentage of the cost of each class of cleaning to the cost as a whole. I have the cost here by the contract system and the cost if the city operates the work, which is about $100,000 to $130,000 less than the contract system, provided the city operated it and paid the same wages the contractor does. If the city operated it and paid the same wages the municipality pays for labor, we would do it for the same price the contractors do it.

The contract system in Philadelphia is something that has been handed down for a great many years. The legislature provides it must be done by contract. There is a reason for that. The contractors have always been very strong in Philadelphia. The leading politicians are mostly all contractors. The contract system we do not advise, and we recommend every year that it be eliminated, but the legislature recommends that it be continued, and we have it down somewhere to a unit cost per man per machine, if we can possibly get it to that system. The force is all uniformed, and the schedule of cleaning is once a week for this street, twice a week for that, and everything is stipulated in such detail that there is absolutely nothing left to the judgment of the contractor.

The same prevails as to rubbish and garbage. We have a system of fines to control the work, but the work is being carried on very successfully and has been for the last two years. We have now in Philadelphia, what we consider and what proves to be the fact, from statistics, one of the finest street cleaning forces in the country. New York and Washington are very much up to date in their street cleaning, and we are only second to Washington. All other cities always will be second to Washington, because they have very little traffic. It is very much easier to keep the streets clean.

CHAIRMAN SOHIER: I am sure we have all learned a great deal from Mr. Connell, and I hope you all noted particularly what he said about the heavy asphalt, that was that you must have your streets cleaned and in good order and a hard surface. We have made so many failures I would be glad to know that nobody else would make the same failure in trying the heavier asphalt on the poorer road.

Gentlemen, it gives me great pleasure at this time to ask Dr. Alfonso Quinonez, who is a delegate from San Salvador, to say a few words to us. He might speak from where he is, if he will. (Applause.)

DR. ALFONSO QUINONEZ: I am sorry I cannot speak English fluently. It has been only a few months that I have been in the United States. My government has received with much pleasure the invitation of this association to be repre-

sented in this congress. In the first meeting we had of this congress Mr. MacDonald told that the object of this congress is to let each one relate experiences in the building of roads. I am sorry I have nothing to tell you because in our country road building is just beginning. We haven't many roads, many things to show you. We came to learn, and for this I only can give you many thanks for the experiences I have heard; and I will carry them with much pleasure to my country. (Applause.)

MR. COBB: Mr. Chairman, I just wish to make a request of the Congress. When the subject of prison labor was up, I had a paper that was written by Mr. F. G. Twitchell, Division Engineer in my office on that subject, that I wanted to read, because I thought that it would lead to considerable discussion on the subject of the present system of working prisoners, and I would like to request the privilege of having that paper inserted in the record.

MR. MAC DONALD: There will be no objection at all.

(Note.—Mr. Twitchell's paper will be found under the subject of "Convict Labor for Highway Work," page 312.)

MR. COBB: In addition to that the subject which I was on the programme for came up too late on Wednesday to be discussed. The subject was "Engineering Supervision for Highway Work." There were only two phases that I expected to touch on, and they were preliminary investigations, the necessity for preliminary investigations, which I think has been largely neglected, and the other was the cost of engineering supervision. A few months ago I wrote to all the highway commissions in the United States requesting the cost of their engineering, and also what they charged to engineering, and, much to my surprise I got answers that showed a great difference in engineering cost. As I remember, it ran from 3 per cent. to 10 per cent. That would, I think, conclusively show that one of two things had happened, that the engineering cost had been charged off to something else, or that they did not have proper engineering supervision. Now the most valuable reply, I am glad to say at this time, I received from our chairman, Colonel Sohier, and I wish to request that I be permitted to furnish the digest of those replies with Colonel Sohier's letters in full to be placed in the record.

MR. MAC DONALD: There will be no objection.

CHAIRMAN SOHIER: I think that will be very interesting indeed.

(Mr. Cobb's paper will be found under the subject of "Engineering Supervision for Highway Work," page 265.)

CHAIRMAN SOHIER: Gentlemen, we are greatly honored at this meeting, I know you feel as I do, by having a delegate here from San Salvador, but we also have Mr. Fer-

nando Cruz, from Guatemala, and I know we would all be glad to hear a few words from him. (Applause.)

FERNANDO CRUZ: Mr. Chairman and Gentlemen: My government having received the invitation of the Pan-American Road Congress, bestowed upon me the honor of coming here to represent it. I don't think they found the right man. We came, naturally, just as Dr. Quinonez told you a moment ago, to learn, to see what improvements we can take back to our country, to make our roads better. Our country lies in the heart of America, of all the great continent. It is just like the link between North and South America. It is a mountainous country. It seems as if it were crushed in, pressed in by the two big parts, the North and South. That is why almost in every circumstance our roads can't be as good as they should. This little data will give you an idea of the difficulty we have. We have some roads, I will mention two of them. One is 75 miles long and the difference of level between the two ends of it is 5,880 feet. Another is 192 miles long and with the same difference in level. Many of our big roads, that cross the big mountain chain, pass at a height not less than 12,000 feet. We have also difficulties with the rain and with the composition of the soil. Many times volcanic ashes make it difficult to maintain the road in good shape. I know that we have had very good lessons. I am sorry that we have not been able to bring here anything of importance that may help in this big problem. (Applause.)

CHAIRMAN SOHIER: We have an invitation here from New Orleans to hold our next meeting in that city. It reads as follows:

New Orleans, La., Sept. 14, 1915.

"Pan-American Road Congress,

Oakland, California.

Gentlemen:

On behalf of the 2,000 members of the New Orleans Association of Commerce, the mayor of the City of New Orleans and the highway department of the state of Louisiana, we extend to you a cordial invitation to hold your next congress in the city of New Orleans.

We have ample facilities for properly handling the meeting and caring for exhibits, and are ready to do whatever may be necessary to insure the success of the meeting if held in New Orleans. Yours very truly,

New Orleans Association of Commerce."

The matter will be referred to the Executive Committee. Now, gentlemen, as there seems to be no other business before the convention, and as Mr. Stern is going to present his paper later, I wish to thank you for your attention, and I wish to say that Professor MacDonald will now deliver the valedictory, or whatever he calls it. (Applause.)

(James H. MacDonald took the Chair.)

CHAIRMAN MACDONALD: Commissioner Sohier, Brother Delegates, is always the dry joker. There is no valedictory to be delivered. There is, however, a grateful recognition on the part of the presiding officer as the mouthpiece of the several associations under whose auspices this convention has been held, to express my gratitude to you all, for not only your patience and diligence, but your attendance. I know it has taken a great deal of courage and considerable self denial for the delegates, with so many counter attractions, to be present at these meetings; and yet I feel there is a compensation for us all in having been privileged to attend the sessions of this congress. It is not by might and it is not by power, as we are scriptually enjoined. The spirit that has been shown here will be contagious. You will all go out from this meeting, in my judgment, those who have been privileged to attend its sessions, better equipped in every way to do your life's work. Those of you who have been privileged to attend the deliberations of this convention, who come as delegates from states that have not as yet entered upon this great work, will carry back treasures greater to your states, or your several political or geographical divisions of this great country, than that ever possessed by the Queen of Sheba. You have had the privilege here during these sessions of listening to papers and hearing discussions from a hundred different sources, covering a range of nearly thirty of the great essentials in road building, from its inception down to the present time. Represented in the expenditure of money, the information which you have had presented to you here has cost hundreds of millions of dollars, and every dollar of that money has been wisely spent. It is not so much that which has been done or the result so far that has come from the doing of it, as the privilege accorded every commissioner or every man who has been the medium, through which this money has been expended, to see where mistakes have been made, and profit by them.

I have often said, show me a man who never has made any mistakes, and I will show you a man that never has done anything. Life is made up in all its successes by mistakes and. as I said in my opening, and I do not take one word away from the statement after having gone through the entire week, this has been a school; and as the director, Mr. Brown, said over at that meeting where we were so delightfully received and so splendidly recognized in our association work by the presentation of medals, that that great institution to which the entire world has been invited and are participating in is a university; so what would be more fitting than that we should come here and attend this great university in its sessions, the greatest in my judgment that has

ever been held, not in point of numbers, but by the character of the papers presented, the knowledge imparted, and the experience on the part of those imparting the knowledge that they have gained and transmitted to you to take to the several parts of our country. I think I speak the mind of every member of the American Highway Association, the American Road Builders' Association, the Tri-State Association and the Pacific Highway Association, when I say that we are very, very grateful indeed for the courtesies which have been extended to us, and we have tried in our way to lend by that which we have imparted, at least in part recognition of the kind courtesies we have received, and we go away feeling just a little tinge of sadness, because the great citizenship which you have here, that has so kindly entertained us and so hospitably treated us in other respects, have not treated us quite right; when we go away we shall leave our hearts behind; you have taken them from us.

We shall always look back as one of the very, very pleasant incidents connected with our great work in propagating this great movement throughout the country, to the pleasant visit, the kindly interest and splendid entertainment, courtesy and hospitality that we have received here all over the Golden Slope. (Applause.)

So, gentlemen, with your permission, we will close the Pan-American Road Congress of 1915, with the lively hope that we may all met again at some future congress held by these associations. (Hearty applause.)

(The congress then adjourned sine die.)

SATURDAY'S AUTO RIDE

About 125 delegates and guests of the Pan-American Road Congress made an automobile trip of inspection on Saturday. They went over the State Highway from Oakland to San Jose, about 50 miles, where lunch was served. Thence the party continued through Santa Clara, Palo Alto and along the peninsula to San Francisco.
